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Predicting the psychosocial outcome of traumatic brain-injured adults.

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PREDICTING THE PSYCHOSOCIAL OUTCOME OF TRAUMATIC BRAIN INJURED ADULTS

by

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ABSTRACT

The serious nature of the psychosocial maladjustment of many traumatic brain-injured (TBI) patients has led researchers to attempt to predict the eventual level of recovery of these patients. The ability to predict the psychosocial adjustment would be invaluable for several reasons: it would allow professionals to provide patients with more accurate information concerning their likely level of recovery and also bring their family's expectations to realistic levels; it could also help professionals identify sooner patients in greatest need of counseling. Numerous studies have demonstrated the predictive superiority of neuropsychological variables over that of the initial indices of severity such as coma length and PTA duration. A sample of 50 TBI patients was followed-up 2 1/2 years postinjury. The overall results clearly documented the extent of the psychosocial maladjustment experienced by the majority of TBI patients. Canonical correlations were used to determine the relative contribution of neuropsychological data obtained at 6 months postinjury, indices of severity of trauma, age, sex, education, and skull fracture with respect to

long-term psychosocial adjustment. The results revealed that although severity of injury and age remained strong predictors of later adjustment, neuropsychological impairment, when expressed in terms of an Average Impairment Rating, surpassed all other variables in terms of its predictive power.

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Chapter I

INTRODUCTION

In the recent past, a considerable amount of work concerning the psychosocial adjustment of traumatic brain-injured (TBI) patients has been conducted. This new trend in research comes after a long period of efforts solely devoted to the assessment of physical deficits following brain impairment (Brooks, 1984). The relative recency of this focus is ironic given the extensive evidence which now clearly demonstrates that psychosocial maladjustment is one of the major and most devastating sequelae of head injury (Brooks, 1984; Goethe & Levin, 1984). That psychosocial adjustment has become an important concept to those involved in the rehabilitation of brain-injured patients is well illustrated by the emergence of books which now exclusively deal with the community re-entry of those patients (Ylvisaker & Gobble, 1987). Research in the area has led to the acknowledgement of the grave impact of psychosocial sequelae, as evidenced by the testimony of the mother of a head-injured boy:

> John's cognitive and social problems have always been the most troubling for both of us. Weak memory, difficulty in taking in new information, poor judgment, social inappropriateness, uninhibited behavior: the impact of these problems seems to outweigh by far John's considerable physical deficits. (O'Brien, 1987, p. 429)

Along with the awareness of the serious nature of the psychosocial maladjustment of many TBI patients came the desire to find predictors of the expected level of recovery. Initially, indices such as CAT scan findings, EEG recordings, severity of damage, coma duration, length of posttraumatic amnesia (PTA), and physical handicap were considered. However, research soon revealed their limited predictive usefulness. For instance, there exist numerous reports of TBI patients who, despite a remarkable physical recovery, have failed to adjust in their daily activities and of patients who, despite the trivial nature of their trauma, complain of prolonged complaints (Jennett, 1972a). Other studies have also reported excellent adjustment in patients having suffered a severe head injury (Newcombe, 1987). The relatively minimal prognostic value of coma duration and length of PTA with respect to long-term psychosocial adjustment was also recently recognized (Bond, 1983).

Over time, the predictive value of neuropsychological variables over purely physical measures with respect to long-term adjustment was highlighted. The ability of such tests to detect subtle cognitive changes may be responsible for their predictive superiority. Several researchers have demonstrated that psychosocial disability and quality of life of TBI patients are indeed most affected by cognitive deficits (Bond, 1975, 1976; Bruckner & Randle, 1972; Crawford, 1983; Heiden, Small, Caton, Weiss, & Kurze, 1979; Jennett, Snoek, Bond, & Brooks, 1981; Roberts, 1976). Furthermore, studies looking primarily at the predictive value of neuropsychological data for everyday functioning in different patient populations have highlighted their usefulness (Baird et al., 1987; Heaton, Chelune, & Lehman, 1978; Heaton & Pendleton, 1981; McSweeney, Grant, Heaton, Prigatano, & Adams, 1985; Newman, Heaton, & Lehman, 1978; Wild, Posthuma, & Bowman, 1985).

The purpose of identifying predictors is quite obvious to professionals involved in the care of these patients. The ability to predict recovery would allow rehabilitation personnel to focus their counseling on those faced with an especially difficult readjustment. It is not uncommon for patients and relatives to be overly optimistic in the early stages of recovery (Jennett & Bond, 1975) and to expect the healing process to proceed in a steady and linear fashion with the passage of time. The ability to predict psychosocial recovery would permit one to accurately counsel the TBI family and assist all family members in realizing that despite a seemingly phenomenal initial recovery, improvement is unlikely to continue at the same rate in the later stages.

Because the implications of pinpointing possible predictors of psychosocial recovery are so important, a review of the literature pertinent to this area will now be presented. This review will focus primarily on an adult population and will be twofold: it will highlight the serious psychosocial maladjustment of TBI patients and present factors which have been found to be important in the prediction of their psychosocial adjustment.

Before embarking upon a review of all pertinent studies, however, it is important to emphasize the difficulties inherent in the assessment of psychosocial recovery. As pointed out by Athelstan (1981), the complex nature of this issue warrants a multidimentional assessment which should be both objective, as when determining the patient's employment status, and subjective, taking into account the patient's satisfaction with life. Unfortunately, the present review will soon reveal the limited number of investigators who have adopted a multidimentional approach. Psychosocial recovery has been measured by numerous variables such as return to work, personality functioning, social adjustment, psychological adjustment, and quality of life. Despite the obvious problems in dealing with different definitions of one construct, a discussion of the findings concerning different areas of recovery of TBI patients will be useful in providing the reader with a comprehensive understanding of the psychosocial impact of a head injury.

Psychiatric Symptoms and Personality Functioning

It is now widely accepted that the mental and personality sequelae following a head injury are far more devastating than the physical complications. Personality changes, intellectual deficits, memory impairment, irritability, poor concentration, nervousness, fatigue, and withdrawn behavior are among the mental sequelae reported by TBI individuals (Jennett, 1972a; Wang & Smyers, 1977). The most important psychiatric manifestations of head-injured patients are said to be character changes of which lack of spontaneity accompanied by apathy and euphoria are the most common as well as neurotic complications (Ota, 1969).

According to Stern (1978), the psychiatric symptoms after a head injury can be subsumed under three chronological phases. The first one, concurrent with the recovery of consciousness, is characterized by PTA, disorganization, agitation, and sometimes aggression. The second phase, during which the acute symptoms disappear, is characterized by introversion, egocentricity, defects of memory and judgment, and catastrophic anxiety reactions to change. Finally, the third stage refers to the relatively permanent personality changes such as judgment disorders, emotional shallowness, lack of anticipation, and rigidity of mental processes.

Grant and Alves (1987) have also proposed three personality syndromes following a head injury but unlike Stern, refer to transient personality changes which occur about the time PTA is resolving. The first syndrome, termed 'organic excitement', refers to the patient's increased energy, euphoria, and psychomotor agitation. The second transient psychiatric syndrome is one of 'paranoid state'. Finally, 'marked aggressive behaviour' reflects the third syndrome that may surface around the time of clearing of PTA.

Lishman (1966) investigated the psychiatric disability of 670 World War II veterans who suffered a penetrating head injury. The follow-up took place 1 to 5 years postinjury. Psychiatric disability was defined, albeit somewhat vaguely, in terms of intellectual, emotional, and behavioral disturbances. The data revealed significant correlations between depth of penetration ($p < .01$), quantity of brain tissue destroyed ($p < .01$), and PTA ($p < .01$) and severity of psychiatric disability, even when intellectual loss was held constant. Sensory or motor defects on the right side of the body ($p < .001$) and right-sided visual field defects ($p < .005$) were also significantly correlated with the level of psychiatric disability although laterality of lesion proved to be non-significant. Nevertheless, Lishman concluded that the left hemisphere and temporal lobe wounds may provide a greater risk for psychiatric disabilities. However, subsequent analysis of 144 patients who all suffered severe psychiatric disability (Lishman, 1968) revealed a marked association of affective disorders and behavioral symptoms with right hemispheric and frontal lobe damage.

The personality changes of severe TBI survivors were assessed by Fahy, Irving, and Millac (1967) in a sample of 67 such patients 6 years postinjury (PTA > 3 days, M time = 37 days). Of the 23 patients who were employed at the time of injury, 52% reported suffering no financial disadvantage, 31% claimed reduced earning capacity, and 17% were still unable to work. Impaired work capacity was prominently caused by psychiatric disturbances such as lack of interest, memory impairment, impaired concentration, and disturbed temperament. Forty-six percent of the sample were socially maladjusted before the injury and at follow-up, only 22.7%

of the patients were judged free of psychiatric sequelae. The results indicated that the severity of neurological and psychiatric sequelae correlated significantly with increasing duration of PTA. This study points out the importance of taking into consideration premorbid personality variables in the assessment of social maladjustment following head injury, as a large percentage of subjects were impaired prior to injury. Consequently, it is hard to attribute the social maladjustment of this sample solely to the effects of the head injury, despite the authors' claim that "psychosocial maladjustment before injury did not prejudice the chances of recovery six years later" (p. 478).

Investigating 291 severe TBI survivors whose PTA exceeded one week, Lewin and Roberts (1979) reported that 40% had recovered with minimal or no physical disability, and that recovery from mental disorder lagged far behind that of physical impairment. In this respect, a coma exceeding 1 month, PTA over 2 months, and increasing age were associated with a poor prognosis. When physical disabilities alone were considered, a 75% recovery rate was obtained whereas consideration of both physical and mental disabilities reduced this recovery figure to a mere 14%. Despite mental problems, 40% still managed to be gainfully employed. Further analysis of this sample also revealed that the degree of neurological function was closely related to return to work (Lewin, Marshall, & Roberts, 1979).

In an attempt to assess the psychopathology of TBI patients, Levin and Grossman (1978) administered the Brief Psychiatric Rating Scale to 62 head-injured patients (*M* age = 25.8) up to some 206 days after injury. The sample was divided into three groups of graded severity on the basis of coma length and presence of neurologic deficits. Severely injured patients (coma > 24 hours) were found to be significantly differentiated ($p < .001$) from the mildly injured ones on the basis of cognitive disorganization, emotional withdrawal, disorientation, unusual thought content, blunted affect, and motor retardation. Hemiparesis ($p < .05$), aphasia ($p < .05$), CAT scan abnormalities ($p < .05$), and abnormal EEG tracings ($p < .05$) were found to be related to the severity of behavioral disturbance. Agitation during the acute stage was also predictive of residual behavioral disturbance ($p < .001$). Laterality of lesion, as inferred from the presence of a hemiparesis or unilateral hematoma, had no effect on behavioral sequelae. This last finding is not surprising in light of the fact that TBI rarely results in damage confined to a single cerebral hemisphere despite indication of lateralized findings.

In a volume devoted to the sequelae of head injury, Jennett and Teasdale (1981) discussed at length the mental sequelae of such patients. They underlined the methodological problems of assessing a dimension which is so subjective, and yet can be more detrimental to recovery than the more readily assessed physical and intellectual impairment. They claimed that personality changes represent the most consistent feature of mental change following blunt head injury. They further listed blunted affect or euphoria, depression, denial of disability, inability to cope, memory impairment, and inability to screen out irrelevant information as additional sequelae. In addition, they reported no association between the extent of brain damage and the mental response to head injury. Finally, in discussing prognosis after a severe head injury, the authors stressed the strong prognostic significance of age, Glasgow Coma Scale score, and duration of PTA. They failed to find strong evidence for the prognostic value of autonomic abnormalities, intracranial hematoma, or laterality of lesion. This last finding is consistent with that reported by Levin and Grossman (1978) and most likely reflects the diffuse damage associated with TBI.

Interested in assessing the emotional reactions of head-injured patients, Fordyce, Roueche, and Prigatano (1983) retrospectively examined 52 TBI patients (PTA > 24 hours) who had been referred for a neuropsychological evaluation and had been administered the MMPI and Katz Adjustment Scale. Patients with a history of antecedent neurological disease were excluded. Patients referred more than 6 months from injury (*n* = 35, *M* age = 26.7) were significantly more affectively disturbed, more anxious and depressed, more confused in their thinking, and more socially withdrawn than those tested earlier (*n* = 17, *M* age = 28.3). The authors attributed the differences to possible premorbid personality factors and increased awareness of impaired functioning on the part of the chronic group with the passage of time.

The authors reported that the differences in emotional functioning between the two groups appeared to be independent of the level of neuropsychological impairment and initial length of coma. The apparent dissociation of emotional and neuropsychological variables is surprising given other indications of a relationship between the two variables (Dikmen & Reitan, 1977). However, as adequately pointed out by the authors themselves, the results of this study may have been biased by the sampling characteristics of the neuropsychological referral base by which chronic patients referred may have been those who had failed to recover adequately. A longitudinal study would shed light on this possible source of bias.

An investigation of the emotional adjustment of 60 brain-damaged patients (35 with predominantly right lesions and 25 with primary left lesions) revealed that both samples obtained similar profiles on the MMPI (Gass & Russell, 1986). Indeed, both right-hemispheric (RH) and left-hemispheric (LH) patients presented with mild dysphoria, dissatisfaction, withdrawal, decreased initiative, and mild somatic preoccupations. Further analysis of emotional adjustment with respect to the degree of aphasia failed to produce significant results when the premorbid educational level was held constant. Unfortunately, a source of confusion was found to exist in the mixed etiology of the sample with both cerebrovascular accident (CVA) and head-injured cases. Black and Black (1982) further suggested a significant relation between posterior lesions in a sample of open head-injured veterans and disturbed personality functioning as indicated by elevated MMPI scales.

In summary, the present review of psychiatric and personality disturbances suggests that personality sequelae are widespread and can have a devastating impact. Extended coma, indices of severity of damage, and advanced age at injury still count among the uncontested adverse predictors of personality disturbances. Evidence for the adverse prognostic significance of prolonged PTA was also presented. On the other hand, laterality of lesion received little support in terms of its prognostic significance, which is not surprising in light of the diffuse pathophysiology associated with most TBI's.

Return to Work

Return to work represents the most consistently adopted measurement of psychosocial recovery (Humphrey & Oddy, 1979). Numerous researchers have reported evidence of unstable occupational capacity and pervasive problems in returning to work following a head injury (Dresser, 1969; Kapaeva, 1985/1986; Rusk, Block, & Lowman, 1969). However, while work undoudtedly plays an important role in the psychosocial adjustment of a TBI individual, it should not be used as the sole index of psychosocial functioning as many investigators appear to have done. Indeed, return to work may tell little of a patient's true ability to carry out pre-injury assignments as she/he may be assigned a lighter workload or may be receiving help from co-workers.

Alternatively, in the event that the patient may be able to carry out all premorbid work-related activities, he/she may have little energy left at the end of the working day for other social activities. As such, return to a premorbid working position does not necessarily mean that the patient is able to function exactly at the same level as before the injury or with the same ease as before. Furthermore, reasons other than physical or mental deficits may prevent patients from returning to work (Jennett & Bond, 1975). Finally, employed patients can still be poorly adjusted psychologically or socially (Athelstan, 1981).

Although the majority of studies strongly suggest adjustment difficulties in returning to work for the TBI patient, a few studies have offered more optimistic results. For instance, Miller and Stern (1965) investigated the degree of long-term social and occupational incapacity of 92 severe TBI patients. The follow-up ranged from 3 to 40 (M = 11 years). All patients had suffered a PTA exceeding 24 hours (M PTA = 13 days) and were aged 6 to 69 years (M age = 34). Approximately 50% of the cases sustained no skull fracture at the time of injury. Analysis of the data revealed that 34 reported earning more than before the accident, 28 claimed their earnings remained unchanged while 15 complained of reduced incomes. However, as pointed out by the authors, the earning capacity may not be an accurate index of occupational adjustment given that wage increases of different professions over such a long period of time are likely to greatly vary. In total, from an occupational point of view, 12% were totally disabled, 35% were downgraded, and 53% suffered no loss of occupational status.

In an even more positive vein, Steadman and Graham (1970) posited that only 2.6% of their sample were unemployed or permanently downgraded. Their assessment of the social status of 415 TBI patients (coma < 1 hour in 85% of cases) 5 years postinjury consisted of a personal interview, questionnaire, neurological examination, and, whenever possible, an interview with a relative. The authors reported that 97% of the patients had suffered no occupational downgrading. This percentage seems incredibly high given other considerably lower figures (Gogstad & Kjellman, 1976). Ten percent of patients complained of personality changes. A PTA duration exceeding 24 hours was associated with personality changes and difficulty in returning to work. Age was also found to be of significance in the report of personality changes.

Although it is not entirely understood why these two studies produced such strikingly different results from the rest of the studies published thus far, it is possible that the authors erred in using indices of work adjustment that were too crude to reveal any adjustment difficulties. In any event, even though such positive results exist, it is now recognized that the occupational disabilities following a head injury are serious.

In one of the earlier studies focusing on the occupational disabilities following TBI, Denny-Brown (1945) followed up 200 TBI patients 18 months posttrauma (age range = 15-54). Although the majority of patients had been comatose for some time, coma did not appear to be a selection criterion. The most common combination of symptoms reported by the patients was that of headache, mental symptoms (nervousness, fears, and anxiety) and dizziness. A total of 110 patients reported either one or more such symptoms.

With respect to predicting unemployment, the author found that age (over 40), coma duration, skull fracture, and prolonged disorientation (over 7 days) were related to later unemployment. Physical symptoms and intellectual deficits played a small role while mental symptoms correlated extremely highly with levels of unemployment. Seventy-six percent of patients with mental symptoms returned to work within 6 months while 100% of patients without such symptoms were back at work in that period of time. The most salient association was that of occupational disability and anxiety state. Unfortunately, nothing more sophisticated that percentages were reported. The fact that some patients were followed-up within 6 months while others waited more than one year is an additional source of bias.

The importance of mental sequelae was stressed in several other studies. A follow-up study of 26 patients who suffered acute head injuries (coma > 1 week) indicated that, 6 years postinjury, 8 patients, all aged 24 years or younger, were able to resume work and presented no residual symptoms (Akerlund, 1959). Eight more reported performing the same work as they did before the injury but complained of headaches, dizziness, fatiguability, and memory impairment. The other 10 reported reduction of their working capacity to varying degree. The most frequent cause of disablement was a combination of mental dulling and deterioration, lack of initiative, and incapacity of intellectual exercice or concentration. When coma lasted over one month, serious neurologic defects and invalidism were highly likely to occur. This study highlighted the devastating effects of mental sequelae on occupational adjustment.

In a follow-up study of 88 severe TBI patients (PTA > 24 hours and/or a compound fracture of the skull or intracranial hemorrhage), Bruckner and Randle (1972) interviewed patients either personally or by mail in order to assess their ability to return to work. Of the 64 patients that were followed-up personally, all received a full neurological examination along with a simple psychological assessment and an IQ test. The follow-up period averaged 5 years and ranged between 3 and 14 years postinjury. Sixty-four percent of the patients reported that they had returned to work within 15 months of the injury. Psychiatric and cognitive factors were found to have the most adverse prognostic significance for return to work with memory impairment being the most important predictor of unemployment. Advanced age (over 40), posttraumatic epilepsy, hemiplegia, sensory loss, and dysphasia were also found to be associated with persistent unemployment. These results may have been confounded by the inclusion of both closed and open head injuries as well as the use of different follow-up periods which renders direct comparison of subjects impossible. No statistics were presented.,

In a 10 to 25 year follow-up, Roberts (1976) investigated the occupational disability of 291 patients

having suffered a severe TBI. All had been unconscious for over a week. The most common personality changes were euphoria, disinhibition, and irritability.
While memory deficits occurred frequently in patients younger than 35 at the time of injury, a combination of a mild memory defect and disabling anxiety was common in those aged over 35. Rapid improvement in the first month was a sign of favorable prognosis while prolonged PTA and advanced age were both related to the degree of disability.
Impairment of personality or intellectual function was the cause of occupational handicap in two-thirds of cases while neural disability, as measured by the presence of akinesia, imbalance, ataxia, paresis, and sensory deficit, was responsible for a decline in the level of employment in only 25% of cases. Unfortunately, this study was almost purely descriptive with no report of statistics.

In yet another study, the significance of age and coma on the capacity to return to work was assessed (Carlsson, von Essen, & Lofgren, 1968). A 1 to 10 year follow-up of 325 patients with severe TBI (coma > 12 hours) revealed that 'mental restitution' was apparent in 82.2% and failed to appear in 17.8% (the authors use return to work as an index of mental restitution, but it is highly unlikely that such a close relationship can be established between the two. As such, 'return to work' will be used as a more appropriate label for what the authors measured). The ability to resume former work was found to decrease with increasing age and increasing coma duration. Of patients aged 21 to 50, all returned to work if their coma lasted less than 24 hours while only 50% were able to resume former work if the coma lasted more than 7 days. The authors further noted that the restitution time necessary for each day of coma was directly proportional to the age of the patient at the time of injury. The authors offered a regression equation to calculate restitution time which incorporates coma duration and age. However, a phenomenon as complex as the ability to resume former activities is unlikely to be amenable to direct prediction via an equation. Finally, the authors erred in using follow-up periods that varied too greatly.

The prognostic value of unconsciousness was stressed by Adey (1967) in a follow-up of 78 TBI patients (impaired consciousness exceeded 24 hours) 5 to 15 years postinjury. Whenever possible, a close relative and doctor were also asked to fill out questionnaires on the patient. Looking at the likelihood of return to normal life and employment, Adey mainly focused on personality changes and neurological defects. Nineteen patients reported a decline in occupational status and 23 reported some lasting deficit which prevented them from returning to their normal preaccident state. Duration of unconsciousness was found to be of prognostic significance: only 25% of patients whose period of unconsciousness lasted less than a month were unable to lead a normal life as compared with 60% of those with an impaired consciousness of over one month ($p < .05$). As well, only 5.8% of the former group was unemployed in contrast to 50% of the latter group ($p < .01$). Unfortunately, the follow-up period of this study was too variable to allow any definite conclusions. As well, the fact that each patient was judged as leading a normal life or not solely on the basis of a questionnaire seems highly subjective. The guidelines for the decision making were not provided by the author.

Similar results concerning the value of unconsciousness were offered by Heiskanen and Sipponen (1970). A total of 204 TBI patients who had been unconscious for more than 24 hours filled out a questionnaire 3 to 5 years after the injury. The results revealed that 43% of survivors were totally disabled. Age was found to be a significant predictor of outcome as less than 30% of patients over 50 years of age were able to return to work while more than 70% of patients under age 20 were able to return to work or school. This age effect may reflect the fact that younger people are more likely to be encouraged to return to work while people aged over 50 may choose to retire early. The older people may also have greater difficulties returning to work because of the nature of their position which is likely to be more complex. A significant correlation between length of unconsciousness and disability was also noted: no patient who had been unconscious for more than 4 weeks returned to work. The length of coma after which rehabilitation for work was not favorable became shorter with advancing age. It is unfortunate that only percentages were reported, even moreso since the authors claimed that Student's t-tests were calculated. The value of this study would be greater had levels of significance been reported.

In yet another study on the prognosis of severe head injuries, the employment status of 72 TBI patients (M age = 22.8 and coma > 24 hours) was assessed up to 15 years postinjury (Gilchrist & Wilkinson, 1979). The prognostic factors were derived from a detailed medical history, social history, and psychological evaluation that were carried out upon admission to the hospital. The follow-up indicated that, 15 years later, 28 patients were working, 27 resided at home but were unemployed, 13 were in the hospital, and 4 had died. Prolonged unconsciousness ($p < .001$), extent of neurological damage ($p < .05$), severe mental changes ($p <$

.005), and unstable family background ($p < .05$) were factors which adversely affected return to work. Age did not prove to be significant in predicting employment status. This seemingly contradictory result is not surprising considering that two-thirds of the sample was under age 25. Cerebral hypoxia also seemed to play a role in preventing return to work although the number of cases falling under this category was too small ($n = 8$) to allow any conclusive statistical analyses.

Unfortunately, the applicability of these results is limited since both open and closed head injuries were included in the sample. Additionally, the fact that the assessment techniques used to assess domains such as mental changes and adequacy of family support system were not listed renders replicability of the results impossible. Finally, specification of the type of statistical analyses conducted should have been made.

A follow-up study of the residual psychological complaints and work status of TBI patients highlighted the importance of the duration of PTA (Van Zomeren & Van den Burg, 1985). The sample was composed of 57 patients, aged 15 to 60, who suffered a severe TBI and exhibited a PTA exceeding 2 hours (M PTA = 30.5 days). All patients were interviewed and psychologically assessed. The authors reported that 84% of the sample still reported some residual deficits after 2 years. The most common complaints were forgetfulness (54%), irritability (39%), slowness and poor concentration (33%), and fatigue (30%). Some complaints, that is forgetfulness, slowness, poor concentration, and inability to divide attention over two simultaneous activities, were all positively related to PTA, which, in turn, was correlated with return to work: The longer the PTA, the less likely that work would be resumed at the same level as before or at all. The number of complaints did not correlate with measures of severity of injury. The authors suggest a cut-off value of a 13-day PTA rather than Russell's 1-week PTA as a better predictor of poor outcome.

Dresser et al. (1973) further investigated the prognostic value of additional variables for gainful employment following open head injury. Using a military population, they followed 864 veterans (*M* age at time of injury = 22.7) 15 years postinjury. A control group of 121 non-TBI veterans was also followed-up. The quality of preinjury mental status ($p < .0005$), penetration larger than 3 cm ($p < .0001$), hemorrhagic or infectious complications ($p < .001$), and coma longer than one hour ($p < .0001$) were factors of prognostic significance. Additional predictive information could be obtained from the presence of aphasia

($p < .0001$), bilateral visual deficit ($p < .0001$), motor impairment ($p < .0001$), and seizures beyond 30 days ($p < .0001$). The side of injury was not significant in predicting employment status.

The impact of the severity of wounding on work adjustment had also been stressed in a follow-up of World War II veterans who suffered penetrating injury to the brain and suffered at least one posttraumatic seizure (Walker & Jablon, 1961). Indeed, the unemployment rate was found to become progressively more frequent as severity of injury increased. The authors reported that personality seemed to play a role in work adjustment since the unemployed men had a higher proportion of elevated scores on the Hypochondriasis, Depression, Hysteria, Psychasthenia, and Schizophenia scales of the MMPI than the employed men. However, even if one assumes causality at this point, it is possible that work status had an impact on personality as in the case of an unemployed man who becomes depressed because of a lack of work. In other words, the nature and direction of the relationship between these two variables cannot be stated on the basis of these results.

In an attempt to determine which aspects of personal and environmental problems were predictive of occupational adjustment, Lewinsohn and Graf (1973) assessed 368 brain-injured patients (*M* age = 31.1). A control group of 344 patient without any brain damage was also assessed on the same 40 follow-up variables. The unsuccessful patients tended to be older and to be suffering from cardiovascular problems. Poor locomotion ($p < .02$), lack of emotional support ($p < .02$), short attention span ($p < .02$), poor memory ($p < .02$), suspiciousness ($p < .02$), and slowness and lack of motor coordination ($p < .05$) were all significantly associated with outcome for the brain-injured patients only. Other factors such as depression and anxiety were found to be significant but since they also proved significant for the control group, they are not included here. The incidence of personal and environmental problems was more than twice as high in the brain-injured patients. Unfortunately, the sample was highly heterogeneous, comprising a mixture of cerebrovascular disease, head trauma, epilepsy and mental retardation cases.

Return to work was further assessed 18 to 24 months after discharge from a rehabilitation program in 72 brain-injured patients (Gogstad & Kjellman, 1976). The sample was composed of head-injured and CVA cases (with CVA accounting for 58% of cases), and upon discharge, all were judged to be physically independent and able to return to work. The average age of the sample was 44. The follow-up data revealed that, despite the initial prediction, only 40% were working and 67% received an invalidity pension. Advanced age (40 years and older; $p < .01$) and delayed rehabilitation (after 1 year, $p < .05$) both significantly prevented return to work. The authors emphasized the adverse effect of delayed rehabilitation in terms of social and psychological complications. The degree of physical impairment had no predictive power.

Gogstad and Kjellman's results have limited applicability since the sample was underprivileged from a socioeconomic and educational point of view. Furthermore, since all were considered ready to resume work upon discharge, the initial injury could not have been very severe. The relatively low figures 2 years postinjury point out the value of follow-up studies since drastically different percentages would have been reported on the basis of performance at discharge. Similar results concerning the overly optimistic expectations formulated upon discharge have been reported elsewhere (Gjone, Kristiansen, & Sponheim, 1972).

In a series of studies, Najenson and his team investigated the vocational rehabilitation of severe TBI patients. Despite the value of their work, it is believed that the heterogeneous nature of their sample (both closed and penetrating brain injuries) is a major shortcoming of their research. All patients, who had been comatose, were assessed in terms of locomotor function, intellectual performance, communication disorder, and behavior disturbances. In an earlier study which ranged from 1 to 8 years posttrauma (Najenson et al., 1974), it was found that about two-thirds of the patients improved after discharge, especially the ones judged to be independent or able to return to work at that time. Despite this encouraging figure, there was still 64% of those judged capable of sheltered work and 35.9% of those believed to be able to do simple work who were not employed according to capacity. The following factors were found to have an adverse prognostic significance for vocational status: prolonged loss of consciousness ($p < .001$), age above 45 ($p < .001$), severe neurological and motor deficits, epilepsy, aphasia, and hemianopsia.

A different approach to the prediction of vocational outcome was intended in a later study (Najenson et al., 1975). Using a sample of 40 head-injured patients (M age = 27) with an average length of coma of 14 days, the authors stated their intention to investigate the usefulness of four functional parameters which were largely ignored in the 1974 study even though they were assessed: locomotor function, intellectual performance, communication disorder, and behavior disturbances. Patients and relatives were interviewed in the process of rating the above features. Unfortunately, this study was again merely descriptive, offering little in the way of correlating the parameters with chances of vocational rehabilitation. The authors simply reported the percentages of patients exhibiting problems in each area, even though they did mention that the poorest outcome seemed to coincide with cognitive defects. Briefly put, this study added little to the previous one.

It is not until 2 years later that the authors finally carried out the study spelled out in their 1975 methodology section (Grosswasser, Mendelson, Stern, Schechter, & Najenson, 1977). Looking at the vocational rehabilitation of 38 severely head-injured patients 30 months posttrauma, the authors concluded that a combination of behavioral disturbances and anosognosia proved to be the most severe obstacles to a succesful outcome in these patients. Unfortunately, once again, no statistical analyses were reported.

Return to work was further investigated in a later study (Najenson, Grosswasser, Mendelson, & Hackett, 1980). It was found that the gap between expectations at discharge and actual performance (the outcome was poorer than expected) at least 6 months after injury was proportional to the extent of damage. Similar to their previous results, coma duration, aphasia ($p < .025$), and cognitive impairment ($p < .001$) all had significant prognostic value. The present results also revealed the significant contribution of premorbid educational level ($p < .01$). The adverse effect of a lack of high school education has also been reported elsewhere (Smolkin & Cohen, 1974). However, the current study failed to report significant results with respect to motor disability and epilepsy. Finally, even though behavioral disturbance had some influence, though not at a significant level, the authors emphasized the detrimental impact of such disturbance on vocational rehabilitation to the omission of other more significant contributions. Even though this study reported significance levels, the types of statistical analyses carried out were not mentioned.

Muller (1969) investigated the occupational status of TBI patients. A total of 1925 patients having suffered slight or moderate injuries to the brain were assessed up to 12 years posttrauma. It is to be noted that 7% of the sample was composed of children. All patients were given a complete neurological examination including an electroencephalogram and a psychiatric assessment. Age once again proved to be a significant factor. The results reported what the author termed "a relatively high incidence" of psychiatric troubles, that is 5.2%, but the validity of this figure is questionable given the inclusion of 55 cases with known preexisting neuroses, psychoses, or behavior disturbances.

Further noting that a very high proportion of patients with slight head injuries or concussions (79%) had not returned to work 13 weeks posttrauma, Muller spoke of the influence of legal involvement. However, it might be, as suggested by McLean, Dikmen, Temkin, Wyler, and Gale (1984), that patients with a minor head injury are more aware of their deficits, and therefore, more disturbed. Furthermore, as suggested by Stuss and Richard (1982), neuropsychological testing might have revealed deficits not observable in this study because of the crude nature of the examination. In any event, Muller concluded that the incidence of permanent and complete disability was more closely related to social and economic factors than to medical ones. Although the author took care to exclude patients with a premorbid history of neurological disorders or head injury, possibly to ensure the homogeneity of his sample, he nonetheless included cases with preexisting history of alcoholism and epilepsy. The inclusion of these two conditions is likely to have biased the results.

As evidenced by this review, discrepancies exist across studies concerning the occupational readjustment of TBI patients. It is most likely that these differences are attributable to a lack of agreement on the measurement of severity of damage and return to work, and varied length of follow-up (Humphrey & Oddy, 1979; Oddy, 1984). Notwithstanding these methodological differences, the prognostic significance of variables such as severity of damage, advanced age, duration of coma, and PTA were once more demonstrated. Furthermore, the important impact of mental sequelae on returning to work was well documented.

Social Disability

Jennett and his team are well known for the development of both the Glasgow Coma Scale (GCS; Teasdale & Jennett, 1974) and the Glasgow Outcome Scale (GOS; Jennett & Bond, 1975). These authors have conducted several studies on the basis of a large computerized data bank of 1500 cases of severe head injuries which they collected from three countries over a 12-year period (Jennett & Teasdale, 1981). All of their severe TBI patients were comatose for over 6 hours. The value of their studies, however, is limited by two factors: the authors consistently failed to report any statistics, simply reporting results as "significant" or not, and patients with varying kinds of brain injury were all grouped into one category. Nevertheless, the importance of their work warrants detailed review at this point.

The Glasgow Outcome Scale has been used in a series of studies in order to assess outcome following TBI. This scale measures social disability in terms of physical and mental disability (Jennett, Snoek, Bond, & Brooks, 1981) and consists of five categories: death, vegetative state (no meaningful responsiveness), severe disability (conscious but dependent for some daily activities: combination of physical and mental disability), moderate disability (independent but disabled: some previous activities not resumed), and good recovery (has resumed all previous activities). It is scored on the basis of a structured interview.

This scale has been criticized on several grounds. Its lack of sophistication for patients varying greatly in premorbid characteristics (Miller, 1986) and insensitivity to subtleties in cognitive impairment (Hall, Cope, & Rappaport, 1985; Rimel, 1981) have been stressed. Furthermore, the 'severe' category has been described as being too broad as it includes all dependent patients, regardless of whether they are demented or not (Plum & Posner, 1980).

In one of the earlier publications, Jennett (1972b) discussed the prognostic significance of site and degree of brain damage, coma duration, age, and psychosocial adjustment for social recovery. In a subsequent report, Jennett, Teasdale, Braakman, Minderhoud, and Knill-Jones (1976) attempted to predict outcome at 6 months in a group of 600 severe TBI patients. The predictive criteria consisted of age, eye signs during the first week following the injury, degree and duration of coma, and GCS. As well, depth and duration of coma and PTA duration were related to outcome. On the other hand, laterality of lesion (predominantly right or left) and age between the decades of 20 and 60 were not significant. In line with these results, a later study by the same team (Jennett et al., 1979) reported the prognostic significance of depth of coma, pupil reaction, eye movements and motor response pattern for outcome 6 months postinjury. Contrary to the 1976 study, however, later studies have found age to be a reliable predictor of outcome (Jennett et al., 1979; Teasdale, Skene, Parker, & Jennett, 1979).

In a subsequent study, Jennett and his team (1981) assessed the neurological and mental disabilities of 150 severe TBI patients (PTA > 2 days) at least one year after injury (range: 1- 14 years; *M* time = 5.2 years). Patients and close relatives were questionned to determine the degree of personality changes. Formal tests of cognitive function (unlisted) were also administered. The authors found that mental handicaps contributed more significantly to overall social disability than did neurological deficits. Significant personality changes were found in 60% of patients, even in those without cognitive or physical deficits. The data revealed that a PTA of less than 4 weeks was a favorable prognostic factor in determining social recovery.

The impact of residual mental deficits was also noted in a long-term investigation of recovery from severe TBI (Levin, Grossman, Rose, & Teasdale, 1979). Twenty-seven young adults (age range = 16 to 50) whose GCS was 8 or less at the time of admission were interviewed and administered a series of neuropsychological tests over a 3-year period. A separate interview with at least one family member took place. The outcome measures consisted of the Glasgow Outcome Scale and the Brief Psychiatric Rating Scale. Ten patients were said to have attained a good recovery while 12 were moderately disabled and 5, severely disabled. The findings indicated that residual intellectual impairment (*p*

$< .05$ or less), deficient memory storage ($p < .0001$) and retrieval ($p < .03$), linguistic deficit, and personal social adjustment were related to the overall outcome. The presence of oculovestibular deficit was strongly related ($p < .02$) to the eventual level of recovery. The duration of coma significantly differentiated the good recovery group and the other two groups ($p < .03$ or less) while age differentiated ($p < .003$) between the good and moderately recovered groups. The results strongly suggested that the overall social outcome was related to cognitive deficits.

In the same vein, Crawford (1983) reported the more crippling effect of social and intellectual handicaps over physical disabilities. Fifty-one TBI patients were followed-up over a period of 3 years. Relatives and employers were also interviewed to gather additional information on the patients' social recovery. Only 7.8% of patients were said to be completely recovered, 25.5% achieved good recovery, 47% were still moderately impaired, and 27.4% remained seriously impaired. In the moderate and good groups, the emotional and intellectual disabilities were the most disabling and distressing. Close to 25% of the former group and 80% of the latter complained of poor memory and nearly 50% of the moderate group were irritable and aggressive. Unfortunately, the author failed to mention the assessment techniques used to measure social and intellectual handicaps.

Assessment of 160 TBI patients (*M* age = 27) who were comatose for an unspecified length of time was done by Becker et al. (1977). The outcome was defined in terms of the Glasgow Outcome Scale at least 3 months postinjury. The results revealed that 36% made a good recovery, 24% were moderately disabled, 8% were severely disabled, 2% were vegetative and 30% died. The data suggested that patients with intracranial mass lesions (p < .05 or less) and midline brain shift (p < .05 or less) had significantly poorer prognosis than patients with diffuse brain injury. Impaired or absent oculocephalic responses and abnormal motor response to painful stimulation significantly adversely influenced prognosis (p < .001). The authors' failure to reveal an age effect might be related to the very small number of subjects in the older age groups.

Also using the Glasgow Outcome Scale, Heiden, Small, Caton, Weiss, and Kurze (1979) investigated the usefulness of early clinical parameters in predicting recovery. One year after injury, 184 severe TBI patients, with coma duration exceeding 6 hours, were followed-up. Nineteen percent had achieved a good recovery, 16% had attained a moderate recovery, 10% presented with severe disability, 2%

remained in a persistent vegetative state, and 53% had died. Aging correlated significantly with morbidity ($p < .01$) as the percentage of patients achieving moderate or good recovery decreased sharply with increasing age. Other significant parameters which correlated positively with recovery were a GCS of 3 or more ($p < .0001$), preserved eye movements ($p < .001$), and intact motor response ($p < .001$). Permanent mental sequelae (personality changes, impaired attention and retention, decreased judgment, and apathy) were found to be more frequently the primary cause of disability in patients with moderate/severe disability than physical problems were. The authors concluded that physical parameters play a far smaller role as a determinant of social restitution than do psychological factors.

The importance of the GCS for social recovery was further stressed by Young et al. (1981). They followed-up 170 patients who had suffered a closed or open head injury or an intracranial hematoma one year earlier (M age = 26.2). All patients exhibited major focal neurological deficit or had been unconscious for at least 6 hours. The results indicated that 95% of patients with a GCS greater than 7 had a favorable outcome while only 10% of those with a GCS of 3 or 4 lived. However, for those with a GCS of 5, 6 or 7, the outcome appeared to be equally distributed between favorable and unfavorable outcome. When information concerning midline shifts was added to this last group, a significantly higher favorable outcome was found for those with midline shifts smaller than 4.1 millimeters. It is only for this group, however, that the combining of GCS and midiline shift information increased the predictive accuracy. On the other hand, Tabaddor, Mattis, and Zazula (1984) reported that age, Glasgow Coma Scale score, and PTA during the first 3 months were not correlated with social outcome. Indeed, the only significant result that these authors obtained was that of a significant correlation between a dementia rating scale at discharge and GOS 1 year postinjury.

In summary, the work of Jennett and his team has revealed the optimal predictive power of eight items of data that are not mutually exclusive for the social recovery of severe TBI patients: age, Glasgow Coma Scale score, best motor response score (which is subsumed under the GCS score), motor abnormality pattern, pupillary response, eye movements (which is also part of the GCS score), presence of apnea, and trend towards improvement or deterioration at the time of assessment (Teasdale, Parker, Murray, Knill-Jones, & Jennett, 1979). The authors found no support for the prognostic value of multiple injuries involving the abdomen or chest (Jennett et al., 1977), although evidence for a significant adverse effect on social recovery was noted elsewhere (Bowers & Marshall, 1980). To this list of adverse predictors of social outcome, Levati, Farina, Vecchi, Rossanda, and Marrubini (1982), on the basis of a study of 215 severe TBI patients, have added the following: absence of brain-stem reflexes, neurological impairment, deep coma, abnormal motor patterns, arterial hypotension, and presence of mass lesion. Finally, ample evidence exists concerning the importance of mental factors as determinants of social recovery.

Psychosocial Outcome

As stated earlier, the relatively late interest in this area is ironic in light of the fact that social maladjustment is one of the major and most serious outcomes of brain damage (Goethe & Levin, 1984). Fortunately, the proliferation of studies during the last decade has produced a tremendous amount of contributory research. In fact, unlike other areas of research where discrepancies in results are common, most findings in this area have documented the striking psychosocial disability of TBI patients (Brooks, 1984) and have established the fact that few head-injured patients are likely to escape permanent psychosocial sequelae (Grant & Alves, 1987).

In a skillful discussion of the personality and psychosocial consequences of a brain injury, Prigatano (1986, 1987) noted that the personality disturbances of TBI individuals appear to fall into four broad behavioral classes: i) anxiety and catastrophic reaction, ii) denial of illness or anosognosia, iii) paranoia and psychomotor agitation, and iv) depression, social withdrawal, and amotivational states. With respect to psychosocial dysfunction, Prigatano claimed that the most commonly reported psychosocial problems consisted of an inability to maintain gainful employment, loss of pretrauma friendships and relationships, impaired sense of body image, reduced self-esteem, and enhanced dependency on the familial and social systems. He concluded by emphasizing the great influence that personality disturbance has on the psychosocial adjustment of the TBI patient.

In one of the earlier attempts at investigating the social and economical adjustment following acute head injury, Raines, Peterson, Liss, and Caveness (1957) followed-up 281 patients who suffered a closed or penetrating injury to the brain, 2 to 6 years posttrauma. A control group of 100 military subjects without a head injury was also assessed in terms of work, community, leisure and family adjustment. Compared to the controls, the head-injured patients exhibited poorer adjustment in work, leisure, and social activities while their community adjustment appeared unimpaired. Thirty percent of the patients were said to have failed in overall socioeconomic adjustment, irrespective of the type of injury. Age at the time of injury was important for postinjury adjustment with patients aged 19 years and older faring worse. Although the use of school grade attained as an index of emotional maturity is questionable, the results indicated that patients who had completed the ninth grade (and were thus more mature) were more likely to succeed. Even though a heterogeneous group was used, the authors addressed this issue of bias by comparing the performance of patients with closed versus penetrating injury to the brain. They failed to find any significant differences.

Weinstein and Lyerly (1968) investigated the difficulties in work, social, and sexual adjustment of 118 TBI patients (M age = 25.3) who had been unconscious from several hours to several weeks. The follow-up study, which consisted of personal or phone interviews with the patients and family members, was conducted 2 to 13 years postinjury. The sample was divided on the basis of severity of damage (duration of unconsciousness) and laterality of lesion. The results indicated that severity of damage was significantly related to the outcome while laterality was not. A low positive correlation emerged between age and social/sexual difficulties in the less severe group while a low positive correlation was noted between age and employment difficulty in the more severe group. Given the brief nature of the report, these results can only be viewed as tentative.

One of the early noteworthy efforts at studying the psychosocial sequelae of head injury was carried out by Hpay (1971). Two to 5 years after injury, 58 open head-injured patients, who had all been comatose for at least 24 hours, were interviewed. Relatives, friends, employers, and family doctors were also contacted, whenever possible, to document personality changes in the patients. The findings indicated that 24.1% had achieved a complete recovery, 34.5% still presented with minor residual symptoms, 27.6% presented with moderately severe residual symptomatology, and 13.8% remained totally invalid. Nearly 50% of the patients had not returned to their original employment because of sequelae of their head injury.

Hpay found a positive correlation between a PTA exceeding 24 hours and psychosocial sequelae and an inverse relation of age (over 20) to recovery. Interestingly, compared to physical disabilities, the psychological disabilities were found in a higher proportion of patients of all categories (mild, moderate and severe). Overall, physical disabilities affected 36.2% of the entire sample while 67.3% of patients suffered from psychological disabilities. The most common personality changes were irritability, lack of patience, restlessness, disinhibited behavior, aggressiveness, and stubborness. Moreover, 62% complained of disturbances of memory and concentration. Finally, Hpay reported that 65.5 % had returned to their previous social life, 20.7% had suffered obvious change in their social patterns, and 13.8% had become complete social outcasts. For this last group, both physical and psychological symptoms were influential, although the posttraumatic personality change was the main contributory factor.

Another early effort at assessing the psychosocial outcome of a severe TBI was put forward by Bond (1975, 1976) who examined the functioning of 56 TBI patients (M age = 30.16) in the neurophysical, mental, and social domains. PTA exceeded 24 hours in all cases. The duration of PTA was found to correlate highly with the degree of social, mental, and physical disability ($p < .01$). Impairment of intellect and personality, rather than physical incapacity, affected the daily functioning of these patients most ($p < .01$). A PTA exceeding 4 weeks was associated with significant ($p < .001$) memory impairment, loss of work capacity and leisure pursuits. Intelligence, as assessed especially by the verbal subtests of the WAIS, was also found to be significantly ($p < .05$) associated with the level of psychosocial disability. Bond's study also emphasized the fact that mental handicap lead to more serious and devastating consequences than physical deficits. Bond concluded that social disability was due mainly to impaired memory, personality change, and physical incapacity. Unfortunately, the follow-up study was carried over a period of time varying between 3 and 24 months.

In order to assess the community readjustment of 88 severe TBI patients, Rappaport, Hall, Hopkins, Belleza, and Cope (1982) designed the Disability Rating (DR) Scale. This instrument contains 32 items and covers four categories: i) arousal and awareness, ii) cognitive ability to handle self-care functions, iii) physical dependence upon others, and iv) psychosocial adaptability for work, housework, or school. Their results indicated that in general most patients improved over a 1-year period but that few returned fully to their premorbid level of functioning. The DR scores on admission were significantly related to the degree of brain abnormality as mesured by evoked potential patterns. The authors advocated the clinical utility of the DR scale by reporting the significant correlation of the admission DR score and the one obtained 1 year postinjury. However, the validity of the DR scale would be better demonstrated if objective external criteria of community adjustment were used.

Community adjustment was investigated in a pilot study of 135 Vietnam veterans having suffered penetrating brain wounds (Grafman, Salazar, Smutok, Vance, & Brown, 1985). Using an index measure which looked at 14 variables of interest in the assessment of community functioning (such as work and family life), the authors followed up 63 right-hemispheric (RH) and 72 left-hemispheric (LH) patients. In addition, 75 control subjects with no brain injury were tested. A stepwise regression analysis, based on demographic and clinical variables, revealed that different groupings of items were important in predicting outcome, depending on the location of lesion. Indeed, educational level and retained projectile fragments were significant predictors in the RH group while education level, Armed Forces Qualification Test score, and retained projectile fragments were most significant with respect to the LH group.

When the neuropsychological variables were entered in a stepwise regression analysis, the best predictors then proved to be the total years of education, combined Chapman scale scores, variance in reaction time on the Continuous Performance test, and total score from the Beck Depression Inventory. Unfortunately, the direction of the correlation was not mentioned. Interestingly, this study pointed out the value of different outcome variables for each group. For the RH group, the ability to make social contacts, community affairs participation, and absence of legal restrictions were most important, while being employed and participation in community affairs were most important in the LH group.

The social reintegration of coma survivors was assessed at least 2 years postinjury by Pazzaglia, Frank, Frank, and Gaist (1975). A total of 142 patients, whose coma exceeded 24 hours, were subjected to an EEG, neurological and psychological examination, and an evaluation of the quality of their survival. The authors failed to specify what constituted their evaluation of social reintegration and quality of life. Two-thirds of the patients achieved complete social reintegration. In only 13% of cases which achieved partial reintegration and 20% of those who failed completely could the maladjustment be related to the presence of physical sequelae. The quality of survival appeared to depend on the nature of physical sequelae to a certain degree but most importantly on social sequelae. An assessment of the prognostic value of early signs revealed that age over 20, caudal lesions and surgical lesions were associated with poorer outcome.

The importance of psychosocial features in determining prognosis of head injury has also been documented elsewhere. A 1-year follow-up study of 474 TBI patients who had been comatose indicated that patients with a postconcussional syndrome were better distinguished from the recovered group by psychosocial factors as opposed to indices of severity of damage (Kay, Kerr, & Lassman, 1971). Indeed, the 56.4% of patients constituting the recovered group and the 19.9% with the postconcussional syndrome could not be distinguished on the basis of the degree of disturbance of consciousness, the presence of skull fracture, or intracranial hemorrhage. However, a combination of marital status, social class, type of accident, and previous illness correlated significantly with outcome ($p < .01$). Patients belonging to the postconcussional group tended to fall into the middle age group, to be married, to be of social class IV, to have suffered an industrial accident, to have been engaged in a semiskilled occupation, and to have had a previous psychiatric illness.

In a series of studies, Rimel and coworkers focused their attention on the psychosocial recovery of TBI patients. In a preliminary study of 1330 patients with minor head injuries, Rimel (1981) observed that these patients, despite the minor nature of their injuries, experienced severe cognitive, social, and psychological problems 3 months posttrauma. Data based on a smaller sample of patients (Rimel, Giordani, Barth, Boll, & Jane, 1981) whose initial GCS ranged between 13 and 15 and who were unconscious for less than 21 minutes, revealed that the most commonly reported problems were persistent headaches (78%) and memory problems (59%). Only one-sixth of the patients were complaint-free. When employment status was assessed, the 34% unemployment figure was found to be significantly associated with a greater premorbid level of life stress ($p < .03$). The authors noted that the chances of being employed was significantly ($p < .01$ or less) higher for the more priviledged patients (i.e. higher education, higher level of employment, greater income, and higher SES). Interestingly, the younger patients fared worse than the older ones. The length of unconsciousness was not significant with respect to social recovery. This is not surprising given the mild nature of the injuries.

The authors offered two explanations for the high incidence of problems despite the mild nature of the TBI: i) despite the mild injury, neuropsychological assessment could have revealed evidence of organic brain damage, and ii) the psychological responses to injury were likely to have caused a great deal of emotional stress. An additional bias, however, consisted of the high incidence of previous head injury (30%) in the sample. It is likely that the cumulative effects of even mild head injuries might have biased their results. Nevertheless, these findings strongly suggest that the effects of even a minor head injury should not be underestimated.

Finally, the authors turned their attention to the social recovery of patients with moderate head injuries (Rimel, Giordani, Barth, & Jane, 1982). A sample of 170 patients (M age = 34) with GCS between 9 and 12, was assessed using the Glasgow Outcome Scale 3 months following injury. Only 38% achieved good recovery in contrast to 75% of patients with mild head injuries. This time, the unemployment rate, a high 69%, was strongly related to severity of injury, length of coma, CT diagnosis, GCS score at discharge, and PTA duration. This stands in marked contrast to the findings obtained with respect to minor head injuries. Finally, the presence of subdural hematoma proved to be an index of very poor outcome since no patients with a subdural hematoma achieved good recovery while 65% either died or remained severely disabled.

Excellent research on the social recovery of TBI patients has been conducted by Oddy and his team. The strength of their research is based on the specificity of their selection criteria and on the comprehensive nature of their outcome criterion. Indeed, an effective encompassing definition of social recovery was adopted by this team which considered return to work, contact with friends, leisure activities, family life, marital relationship, parental behavior, and financial situation when assessing social recovery.

One of their earlier reports focused on 49 TBI adults, most of them aged under 25 years, whose PTA exceeded 24 hours (Oddy, Humphrey, & Uttley, 1978). A control group of patients with traumatic limb fractures was also used. A close relative was interviewed and asked to fill out a symptom checklist while each patient was administered cognitive tests and asked to fill out a symptom checklist as well. Sixty-five percent suffered from at least one subjective symptom such as poor memory, loss of temper, or fatigue. The cognitive and personality changes were said to predominate among the reported symptoms. Forty-nine percent had returned to work full-time at the same level as before the injury, which means that some patients, despite subjective symptoms, were able to return to work.

A PTA exceeding 7 days correlated significantly with length of delay to return to work ($p < .003$), a decrease in the number of close friends, and the number of subjective symptoms ($p < .02$). Although a significant deficit in the ratings of leisure activities was noted in patients with a PTA over 7 days, it was considered a non-specific finding as the same deficit was found for the control subjects. Therefore, this deficit was more a reflection of disruption of normal life than the effect of the brain injury per se. This clearly emphasizes the importance of using appropriate controls. With respect to return to work, subjective symptoms appeared to have little influence whereas physical disability played a much more important role. The TBI group was significantly more bored than the control group ($p < .005$). Overall, the results indicated that work, leisure activities, and contact with friends were the areas of life most affected by a TBI.

A further follow-up of the same sample 2 years later was conducted by sending questionnaires to both relatives and patients (Oddy & Humphrey, 1980). Essentially the same results were reported with respect to the prognostic value of a PTA exceeding 7 days in the areas of leisure activities, friendships, and return to work. The results further indicated that premorbid nervousness appeared to hinder return to work. Once again, physical deficits were found to influence return to work but remained unimportant in determining social contact. Cognitive changes were associated with diminished social contacts ($p < .05$) while personality changes were associated with poor family relationships ($p < .05$) when at least one other sibling lived at home with the patient.

A more detailed analysis (Weddell, Oddy, & Jenkins, 1980) revealed that two years postinjury, two important factors, physical and mental, emerged as significant predictors of social adjustment. Indeed, neurophysical status ($p < .001$), personality change ($p < .0004$), and memory loss ($p < .0002$) all significantly affected the patients' capacity to return to work. Personality change played an important role in the loss of preaccident friendships ($p < .002$), decrease of interests ($p < .005$), higher frequency of boredom ($p < .01$), and increased dependency on families ($p < .01$). Irritability was the personality change most commonly reported by relatives.

Diminished intellectual capacities, as suggested by a low Matrice score and IQ level below 70, were significantly associated with unemployment ($p < .02$ or less). Finally, when compared to a control group, the TBI group had fewer friends ($p < .0014$), received fewer visits ($p < .005$), and dated less frequently ($p < .002$).

When this same sample was reassessed 7 years later (Oddy, Coughlan, Tyerman, & Jenkins, 1985), many patients still exhibited problems with memory and concentration (this was most commonly reported by both patients and relatives), impatience and irritability, lack of leisure activities, and anxiety and tension. Loneliness was said to be the greatest burden that these patients had to face. Indeed, 60% of the sample had no friends and this was also reported by both relatives and patients. Interestingly, childish behavior was unlikely to be reported by the patients themselves although 40% of the relatives reported such behavior. Similarly, while relatives commonly reported impatience, this was not endorsed by the patients. Up to 40% of the patients were said to deny any difficulties. Little change was noted in terms of physical or cognitive status since the last follow-up conducted 5 years earlier. These results corroborate previous reports of isolation and loss of friendships in TBI patients (Cogswell, 1968).

In a well designed study, McLean, Dikmen, Temkin, Wyler and Gale (1984) investigated the psychosocial functioning of TBI adults 1 month posttrauma. The sample consisted of 102 patients (M age = 26.33) with a PTA exceeding 1 hour and no history of previous central nervous system insult. A control group was made up of 102 adults selected among the patients' pretrauma friends. A battery of psychosocial measures was administered to all subjects: Sickness Impact Profile, modified function status index, head injury symptom checklist, rating scale of subject's perception of functioning, and a structured interview.

The TBI subjects stated more frequently that they suffered from headaches, fatigue, dizziness, blurred vision, concentration problems, sensitivity to noise, memory problems, and insomnia. This study highlighted the value of using control subjects as they, too, endorsed irritability, temper problems and anxiety, which suggested that these symptoms were not the sole effect of a head injury. Notable differences were found between samples, especially in the areas of resumption of major role activities such as work and leisure/recreational activities. An analysis of the effect of depth and duration of coma and PTA revealed that the relationship between severity and psychosocial functioning differed for various measures. Thus, even though no significant differences emerged between the severity subgroups, it was noted that psychosocial dysfunction tended to decrease with decreasing severity while the number of postconcussional symptoms tended to increase slightly with decreasing severity. The authors concluded that, on measures of emotional behavior, the inverse relationship between severity of injury and dysfunction might be due to the fact that patients with milder head injuries are more aware of their losses than patients with more severe injuries.

One of the longest follow-up studies of TBI outcome was possibly that of Thomsen (1984). Forty TBI patients, whose PTA lasted at least 1 month, were followed-up 10 to 15 years after their initial injury. Questionnaires were sent to both patients and relatives. The results indicated that social isolation, which was reported in 68% of cases, and psychosocial sequelae remained the most severe burden of those patients despite the presence of numerous other severe complaints. Seventy-five percent complained of poor memory; 65%, of changes in personality and emotion; 53%, of poor concentration and slowness; and 55%, of lack of interests. The personality and emotional changes were especially frequent among the youngest patients (younger than 21 years old).

A listing of symptoms by age revealed that the frequency of reported problems differed for patients aged younger and older than 21 years of age. The most frequent complaints of the younger group included poor memory (71%), loss of social contact and fatigue (59%) as well as distress and lack of interests (53%). For their part, the older patients reported problems of memory (78%), loss of social contact (74%), irritability (65%), and poor concentration (61%). More than 25% remained dependent and practically all received a disablement pension. The worse overall outcome was noted in cases with severe brainstem involvement or anterior lesions or both. With respect to return to work, the results were encouraging as several patients regained at least some work capacity despite severe deficits.

The social adjustment and social interaction of patients having suffered a severe TBI were evaluated by Newton and Johnson (1985). The sample, which was composed of 11 TBI patients (M age = 34.8) with an average coma length of 11.4 weeks, was contacted an average of 5.4 years posttrauma. Two control groups, 20 psychiatric outpatients and 32 normal undergraduates, were also included in this study. Each subject completed questionnaires regarding social and evaluative anxiety and self-esteem, and were administered a neurophysical scale and the WAIS while relatives were asked to complete the Katz Adjustment Scale. The social adjustment of the TBI patients, which was significantly poorer than that of the normal controls, was characterized by poor social performance ($p < .001$), high social anxiety ($p < .05$), and low self-esteem ($p < .01$).

With respect to the Katz Adjustment scale, even though the TBI patients obtained scores which paralleled those of the psychiatric population in many of the areas, they were still, in comparison, more confused ($p < .01$), less anxious ($p < .001$), less nervous ($p < .001$), and exhibited less general psychopathology ($p < .01$). They were also assigned significantly more negative traits on seven dimensions when compared to the general population data. Finally, relatives of the TBI patients reported that the latter engaged in fewer socially expected activities ($p < .001$). IQ was not signicantly correlated with social performance. This represents one of the few studies to focus on the actual social performance of TBI patients but unfortunately, the small sample sizes prevented the formulation of any firm conclusions.

Klonoff and coworkers have recently attempted to measure the quality of life (QOL) of 78 TBI patients, aged 17-40. They chose to assess QOL in terms of social and emotional functioning, daily living activities, and recreational activities, and based their assessment on the Sickness Impact Profile (SIP) and interview data. Each patient was interviewed and given a neuropsychological battery. Relatives were also asked to complete a questionnaire (Katz Adjustment Scale-Relatives' Form). In a preliminary study, Klonoff (Klonoff, 1984/1986) suggested that frontal lobe damage, severity of injury, and residual cognitive deficits might impede recovery and restoration of preinjury QOL. Education, seizures, and injury-test interval were found to be modest predictors of QOL. Strongest indicators of QOL were related to cognitive performance, specifically in the areas of motor functions, memory and constructional ability, and initial Glasgow Coma scale scores. Similar results were reported in a subsequent publication (Klonoff, Costa, & Snow, 1986), although the latter study emphasized more the inverse relationship between QOL and neuropsychological impairment.

A more in depth analysis of this sample (Klonoff, Snow, & Costa, 1986) revealed that 19% reported being unemployed, 22% worked less than 1 year continuously postinjury, while 35.9% were unable to maintain full-time employment continuously after the injury. These figures stand in marked contrast to a 78.3% employment figure before injury. Physical symptoms were reported in 61.5% while 57.7%

reported psychological complaints. The most common psychological complaint consisted of a memory deficit which appeared in 60% of cases. Irritability, concentration, and depression were also common. On the basis of the interview and SIP data, the greatest postinjury dysfunction was reported in the areas of psychosocial functioning, work, recreation, mental alertness, and pastimes. Unfortunately, the exact nature of the interview was not mentioned.

This review of the psychosocial difficulties following a TBI clearly indicates that such difficulties count among the most devastating consequences of brain damage. Adjustment difficulties in returning to work, leisure activities, and interpersonal relationships are commonly cited. Among the possible predictors of psychosocial impairment, prolonged PTA, personality changes, and age are mentioned. Although severity of damage seems to be influential in some studies, others present an inverse relationship between psychosocial difficulties and severity. In general, psychological factors are once more found to be more important than purely physical parameters in determining recovery. This suggests that it might be easier for an individual to deal with obvious physical changes than to adapt to the subtle psychological changes which he/she has suffered.

Predictive Value Of Neuropsychological Data

Thus far, this review has demonstrated that variables such as age, coma duration, and indices of severity of damage can predict psychosocial adjustment but only to a limited degree. The crude nature of these predictors is most likely at fault: Neuropsychological testing, on the other hand, because of its ability to detect cognitive changes which might otherwise go unnoticed, would be more valuable in the prediction of psychosocial functioning. Indeed, Stuss and Richard (1982) point out the dilemma of professionals faced with patients believed to have achieved a good recovery on the basis of a lack of neurological signs and apparent recovery of higher mental functions, who nevertheless still report subjective complaints. Instead of offering malingering or accident neurosis as an explanation as has been done elsewhere (Muller, 1969), Stuss and Richard propose that the problem results from not seeking the specific dysfunction. A comprehensive neuropsychological examination would evaluate cognitive sequelae in sufficient detail to determine the presence of impairment in higher mental functions that may be responsible for the patient's inability to resume former activities.

Until quite recently, there existed little documentation of the relationship between neuropsychological test results and everyday functioning (Chelune & Moehle, 1986). Fortunately, more and more efforts are now devoted to assessing the predictive usefulness of neuropsychological data. Thus far, there exists evidence concerning the validity of neuropsychological tests with respect to self-care and independent living, academic achievement, and vocational functioning (Heaton & Pendleton, 1981), occupational status in a heterogeneous adult sample (Heaton, Chelune, & Lehman, 1978; Newman, Heaton, & Lehman, 1978), inpatient rehabilitation for stroke patients (Anderson, Bourestom, Greenberg, & Hildyard, 1974), social adjustment in a normal geriatric population (Gilberstadt, 1968), and real-world dysfunction in cerebral revascularization candidates (Baird, Adams, Ausman, & Diaz, 1985; Baird et al., 1987). As pointed out by Chelune and Moehle (1986), the involvement of neuropsychology in issues of everyday functioning is a relatively recent phenomenon. For a complete review of studies relating neuropsychological performance to everyday functioning in diverse populations, the reader may refer to Heaton and Pendleton (1981) and Chelune and Moehle (1986).

The social implications of neuropsychological deficits were addressed by Dikmen and Reitan (1977). An 18-month follow-up study of 27 TBI adults (*M* age = 31.07) was conducted to study the relationship between neuropsychological impairment and resulting emotional problems. On the basis of their neuropsychological performance on admission, patients were divided among two groups: i) normal or mildly deficient and ii) moderately or markedly deficient. The MMPI and a neuropsychological battery including tests of intelligence, memory, sensory-perceptual and motor functions were administered. The results revealed that patients with significant initial and residual neuropsychological deficits experienced greater, although not always at a significant level, emotional distress than those belonging to the 'mild' group. More specifically, the 'moderate' patients complained of anxiety, depression, somatic complaints, and feelings of strange experiences although these complaints tended to subside with time. An age effect was noted as the more impaired patients were older than those with milder deficits. Unfortunately, the sample description was vague and the percentage of open versus closed head-injured cases was not made clear.

The usefulness of a neuropsychological battery in the prediction of everyday functioning was further assessed in a sample of patients with hypoxemic obstructive pulmonary diseases (McSweeney, Grant, Heaton, Prigatano, & Adams, 1985). The authors advocated that neuropsychological functioning was more consistently related to activities of daily living and social role performance than to emotional variables. In more detail, canonical correlations indicated that two classes of neuropsychological tests predicted two types of everyday dysfunction: the motor and psychomotor speed tests were found to relate to physical mobility, self-care, home management, and socialization while aphasic difficulties impaired the ability to communicate. Among the more significant predictors of everyday functioning, Trail Making Test-Part B, Grooved Pegboard and Hand Grip stength were noted. The prognostic importance of neuropsychological tests still held after age and education effects were controlled for.

In a noteworthy effort, Heaton, Chelune, and Lehman (1978) attempted to assess the predictive usefulness of neuropsychological tests (expanded Halstead-Reitan battery) and MMPI for the patient's employment status and everyday functioning. When looking at the employment status of 381 neuropsychological referrals, aged 17 to 64 (M age: 37.7), the authors found highly significant differences regardless of the specific source of referral: the unemployed group showed grestest pathology on all tests (mildly impaired range), the full-time employed group performed relatively normally, and the part-time employed group obtained intermediate scores. On practically all tests, the full-time employed and unemployed groups were significantly different ($p < .001$). The most reliable differences between these two groups occurred on the Halstead-Reitan tests and the WAIS. Similar results were obtained for the MMPI with the unemployed group displaying significantly more personality disturbances than the full-time employed group ($p < .001$). A discriminant function analysis, based on the Average Impairment Rating, PIAT, WAIS, Story Memory, and MMPI satisfactorily discriminated between the unemployed and full-time employed groups. The most weight was given to the Average Impairment Rating. The neuropsychological function correctly classified as much as 74.2 percent of subjects while a combination of the neuropsychological and MMPI functions accurately classified 83.7 of subjects.

In a related study, Newman, Heaton, and Lehman (1978) used the same battery to predict the future employment of 78 patients (M age = 36.1) with stable neurological conditions 6 months after their initial neuropsychological evaluation. The scores on the Halstead-Reitan battery, WAIS and MMPI were highly correlated with employment status, income, and skills required on the job. All significant correlations linked poor test performance with unemployment, low income, or low job requirements. The authors further reported that a stepwise regression analysis revealed a significant multiple correlation of .53 (p < .01) between chronic unemployment and the 10 most sensitive predictor variables. Unfortunately, these variables were not all listed.

Nevertheless, the authors reported that most of the effect was attributable to the Average Impairment Rating which could be used to correctly classify 78% of patients. The Halstead Impairment Index, Tactual Performance Test score, Trail Making Test and Category Test were also important predictors. Wage income was found to be largely predicted by the Story Memory Test and TPT-time scores. MMPI results were less predictive of future employment status than they had been for current status. The authors suggested that this might be due to negative emotional reactions related to unemployment. The authors once again concluded that neuropsychological measures had significant predictive validity with regard to future employability, wage income, and job skill requirements. Unfortunately, the sample was highly heterogeneous and composed of patients with a wide variety of etiologies.

Wild, Posthuma, and Bowman (1985) attempted to replicate Heaton, Chelune, and Lehman's 1978 study using a more homogeneous sample. They chose to investigate the relationship between neuropsychological tests and everyday life performance 7 months or more after injury in 87 TBI patients. All patients, aged 18 and over, were classified into a mild (n = 13, no loss of consciousness), moderate (n = 33, PTA < 49 hours), or severe (n = 41, PTA > 48 hours) group. The patients had been subjected to an intellectual, neuropsychological, personality, and vocational assessment when hospitalized and were mailed a questionnaire at the time of follow-up.

The preliminary results revealed that 68% reported demotion or inability to work. The correlations between the 34 variables which had been selected as potential predictors (IQ, severity of damage, neuropsychological scores, and MMPI) and employment status and daily life problems were all quite low. Regression analyses indicated that the best subset of variables (R=.62, p = .000) for the occupational status was that composed of Keytests (percentage of impaired tests among the Impairment Index, Category Test, TPT location, and Trail-Making B), tapping with the dominant hand, estimated Full Scale IQ (the basis for estimation was not described), TPT Total time, and the MMPI Masculinity-Femininity and Social Introversion scales. This clearly indicated the usefulness of neuropsychological tests (Keytests) for predicting future occupational status as 34%

of the variance could be explained by such measures. The best subset of variables for daily life problems ($R=.56$, $p = .0001$) consisted of severity of trauma, WAIS-R Full Scale IQ, and the MMPI Lie and Depression scales. A negative correlation was noted between the severity of trauma and daily life problems, indicating that the more severely injured patients complained less about changes in their daily performance. These results are similar to those of Fordyce, Roueche, and Prigatano (1983).

Investigating the long-term impact of neuropsychological deficits on social functioning following a TBI, Dye, Saxon, and Milby (1981) evaluated 48 adults (*M* age = 23.8) who were comatose for at least 1 hour. The study ranged over a period of 3 years postinjury and involved the administration of the Halstead-Reitan Battery, WAIS, and various questionnaires assessing levels of social functioning. A control group of 16 patients (*M* age = 24.9) hospitalized for other types of traumatic injuries was also subjected to the same battery of tests.

The results once more revealed the adverse prognostic significance of prolonged coma. All TBI patients fared worse on the neuropsychological battery than the control group. Duration of coma (cutoff value of 48 hours) significantly affected performance on a variety of neuropsychological measures. The Impairment Index and Tactual Performance Test Total Time were most sensitive since they differentiated between each level of coma and the control group. Further analysis indicated that subjects with longer coma were likely to experience even greater cognitive impairment when tasks contained a motoric component. When assessing social functioning, the same relationship held for duration of coma: subjects with longer coma were significantly less likely to be restituted (p < .05). In light of the common relationship between neuropsychological impairment and the inability to resume former levels of functioning with coma duration, it is possible that cognitive impairment and social functioning be closely related. Despite the great promise of this study, the follow-up was not conducted at a fixed time for all subjects, some being tested within 18 months of injury and others being tested up to 3 years later. Such variability in the length of follow-up intervals is likely to have confounded the results.

The relationship of neuropsychological impairment to presenting symptoms and quality of life was investigated in a well designed study by Baird, Adams, Ausman, and Diaz (1985). Forty-six surgical candidates for cerebral revascularization (M age = 62) were studied. An interview conducted with each subject yielded information on basic demographic variables, presenting symptoms, and other medical parameters. The subjects were thereafter administered a series of neuropsychological tests and the Sicknesss Impact Profile (self-assessed health status). The Average Impairment Index, medical index, and education independently correlated significantly with the Sickness Impact Profile ($p < .05$). Age did not correlate significantly with the Sickness Impact Profile.

A regression analysis yielded no significant regression coefficients although symptom duration and stroke-related factors were more important in yielding information concerning quality of life than were the neurobehavioral summary score or the premorbid intelligence. The authors hypothesized that the non-significant relationship between neurobehavioral impairment and everyday functioning might be due to the mild symptomatology of their group. It could also be reflective of the global nature of the index of neuropsychological impairment that was used. With a larger sample, it would be most interesting to look at the contribution of individual neuropsychological tests. This study is nonetheless valuable given the paucity of studies which have attempted to document the relationship between neuropsychological functioning and everyday adjustment.

In a later study, Baird, Brown, Adams, Shatz, McSweeney, Ausman, and Diaz (1987) attempted to relate neuropsychological deficits to everyday dysfunction in a sample of 95 cerebral revascularization candidates. A comparison group was composed of hospitalized patients with spinal complaints. Patients received a full neurological examination before the operation. Measures of health, ADL, psychiatric and psychosocial functioning, anxiety, personality, and neuropsychological performance constituted the outcome assessment. Patients were also observed on simulated everyday tasks. Relatives filled out the Katz Adjustment Scale and a life quality index.

The results indicated that the revascularization candidates reported more impaired psychosocial functioning ($p < .001$), higher depression ($p < .05$), higher situational ($p < .001$) and trait anxiety ($p < .01$), and a tendency towards more inappropriate behavior and psychiatric symptoms. They also tended to fail the telephone call and route-finding simulation tasks more than the control subjects. On smaller sample sizes ($n = 38$ for patients, and $n = 19$ for controls), a neuropsychological examination was conducted. The Mean Impairment Rating and Trail Making Test-Part B scores most successfully predicted the Sickness Impact Profile results. Further analyses revealed that the

Mean Impairment Rating was also significantly correlated with three other outcome measures while Trail-Part B was significantly correlated with two outcome measures. Overall, all correlations between selected neuropsychological scores and life quality measures were modest, which led the authors to conclude that prediction of real-world performance would most likely require the use of multivariate combinations of measures. Finally, a stepwise regression analysis revealed the significant contribution of the MMPI Depression scale and the Mean Impairment rating ($p < .0001$) when these variables, along with an index of premorbid intellectual functioning, were entered in the analysis of the SIP.

Finally, in relation to the association between neuropsychological performance and everyday functioning, the beneficial effects of a neuropsychologically oriented rehabilitation on psychosocial adjustment has been documented (Prigatano et al., 1984). Six months after entering such a rehabilitation program, 18 TBI adults were assessed in terms of their neuropsychological functioning, personality characteristics, and psychosocial adjustment. Their performance was compared to that of a control group of TBI patients who underwent traditional rehabilitation. The experimental subjects showed a trend for better neuropsychological performance and exhibited more improvement in their personality functioning. The relatives of these patients also reported lower levels of helplessness, social withdrawal, general psychopathology and restlessness or hyperactivity. The authors concluded that neuropsychological rehabilitation could improve the psychosocial adjustment of TBI patients.

Predictors of Psychosocial Adjustment

The present review has revealed many inconsistencies concerning the ability of TBI patients to resume former activities in different areas. This most likely reflects the fact that numerous studies containing otherwise valuable data failed to give adequate descriptions of their samples, statistical levels, time elapsed since onset of brain insult, or assessment techniques. Additional sources of bias may reside in a failure to account for geographical social parameters (Wagner, 1986) and premorbid psychosocial adjustment (Goethe & Levin, 1984).

Nevertheless, despite the obvious shortcomings of many of the studies reviewed here, the general conclusion is that the majority of TBI patients suffer serious and devastating psychosocial adjustment difficulties, sometimes irrespective of the severity of their insult. Furthermore, these studies have pointed to several important predictors of different areas of psychosocial functioning. As illustrated in Table 1, found in Appendix A, the psychosocial adjustment of TBI patients is adversely affected by demographic variables such as advanced age; extended coma, prolonged PTA and other indices of severity of damage; premorbid psychiatric illness; and personality dysfunction.

The present review also suggests that psychological and cognitive impairment such as memory impairment or loss of concentration are important determinants of psychosocial recovery. A qualitative analysis of the majority of studies discussed in this review further reveals that, whenever neuropsychological data are used among the possible predictors, they prove to be most significant in predicting psychosocial functioning. Consequently, it seems warranted to conclude that all future investigations on the psychosocial adjustment of TBI patients should definitely use neuropsychological testing as part of the predictive process. There exists little doubt that neuropsychological data offer much promise in differentiating the patients who can expect a good recovery from those who will experience various degrees of psychosocial difficulties.

Purpose

As indicated in the above review, neuropsychological data have proven valuable in the prediction of psychosocial adjustment. However, the numerous shortcomings of many of the studies still prevent firm conclusions concerning the type of neuropsychological impairment that will prove most relevant in the prognosis of recovery. For one, the neuropsychological assessments in any given study are often done at different intervals. For instance, the neuropsychological profile of a patient 3 months postinjury is often compared to that of a patient 3 years posttrauma with little consideration for changes that may occur over time. Even though it is generally accepted that most recovery has taken place within 6 months of the initial injury (Bond, 1976, 1979; Bond & Brooks, 1976; Grosswasser, Mendelson, Stern, Schechter, & Najenson, 1977; Hall, Cope, & Rappaport, 1985; Heiden at al., 1979; Jennett & Teasdale, 1981; Oddy & Humphrey, 1980; Weddell, Oddy, & Jenkins, 1980), several authors advocate that improvement in psychosocial function can continue for several years (Thomsen, 1984).

Another possible flaw concerns the exclusive use of summary measures of neuropsychological impairment which may mask the subtle deficits observed on any particular subtest.

As well, samples often include a mixture of open and closed head-injured patients as well as patients who have suffered cerebrovascular accidents. Finally, many studies use insensitive tests of psychosocial adjustment to the detriment of more sound measures.

The primary purpose of the present research was to study the predictive value of neuropsychological testing with respect to the psychosocial adjustment of adults having suffered a TBI. It was hoped that such undertaking would fill the apparent lack of comprehensive studies of the degree of association between early neuropsychological assessment findings and psychosocial outcome (Benton, 1987). The neuropsychological data were consistently collected at 6-months post-referral. Since availability of patients and hospital resources changed slightly over time, the time frame accordingly varied somewhat although all neuropsychological assessments were conducted between 6 and 12 months postinjury. The expression of neuropsychological performance was threefold: i) individual test scores, ii) factor scores, and iii) Average Impairment Ratings. Finally, psychosocial adjustment was measured with scales sensitive enough to ensure that a wide range of facets of recovery were considered. As evidenced from this brief description, the present research attempted to correct many of the methodological flaws noted in previous studies by ensuring the following: i) homogeneity of the sample, i.e., all closed head injuries and no open head injuries, ii) constant time frame for all neuropsychological assessments, iii) use of a variety of measures of neuropsychological performance (individual tests, factor scores, and Average Impairment Ratings), and iv) comprehensive assessment of psychosocial adjustment.

Hypotheses

1. It is hypothesized that the neuropsychological variables taken at least 6 months postinjury will be better predictors of psychosocial adjustment than demographic variables or indices of severity of damage such as age at time of injury, education, presence of skull fracture, Glasgow Coma Scale score on admission, length of PTA, and coma length. Unlike other promising studies which have looked at neuropsychological data as indicators of psychosocial adjustment (Klonoff, Costa & Snow, 1986), the present study intends to use them as predictors in an effort to answer a clinical "need to know" on the family's part concerning the expected future daily performance of its TBI member.

2. It is predicted that the degree of psychosocial adjustment will be inversely proportional to the severity of neuropsychological impairment, i.e., the better the psychosocial adjustment, the less impaired the neuropsychological performance.

3. It is further hypothesized that, among the neuropsychological variables, indices of attention and memory functioning will be most relevant in predicting psychosocial adjustment. This prediction is based on the known site of damage of a TBI and the clinical observation that impairment in these two areas is most commonly reported by TBI patients who are having difficulty resuming premorbid lifestyles.

Chapter II

METHODOLOGY

Subjects

The subjects for this study were selected from two major hospital centers in Ottawa: the Ottawa General Hospital and St. Vincent Hospital. The majority of the participants, who were predominantly White, resided in the Ottawa-Hull region at the time of injury, an area in which a large percentage of the population is employed by the federal civil service. Eligibility for participation was established on the basis of several inclusion/exclusion criteria. Criteria for inclusion consisted of a documented traumatic brain injury (TBI) no earlier than 1984, subsequent hospitalization for monitoring and/or treatment of the injury, available neuropsychological data gathered 6-12 months postinjury and age at time of injury ranging between 16 and 50 years of age. The ceiling restriction on age was imposed to minimize the possible confounding effects of age-related cognitive and social adjustment changes. Patients having suffered varying degrees of severity of TBI (mild, moderate or severe) were admissible. Exclusion criteria consisted of significant aphasic disturbances which would have prevented the administration of a comprehensive neuropsychological battery at 6-12 months postinjury, past hospitalization for drug or alcohol abuse, previous head injury or psychiatric care, and past or present history of neurological disease known to affect the central nervous system.

One hundred and two letters were originally sent out to prospective participants. Ten letters were returned because of unknown whereabouts of the addressees. No response was obtained from 28 participants, reflecting one of three possibilities: refusal to participate, loss of letters in the mailing system or non-rerouting of letters sent to former addresses. Eight individuals personally indicated their refusal to participate. A total of 55 subjects originally accepted to participate, representing a 54% response rate. However, two eventually withdrew their participation, one because advised to do so by his lawyer and another one, because of "lack of time". Furthermore, three other participants had to be excluded as a more detailed interview indicated that they did not fulfill the inclusion/exclusion criteria. One man was rejected because of a past history of hospitalization for drug overdose while another one was judged inadequate for the present research because of documentation of cerebral hemorrhage secondary to a former head injury. Finally, a teenage girl was excluded because of the incomplete nature of her postinjury neuropsychological assessment. The final sample consisted of 50 TBI patients.

While males and females were equally represented in this sample, the majority of participants were right-handed (96%) and English-speaking (76%). At the time of the accident, the overall sample of 50 TBI patients was characterized by a mean age of 27.20 (SD: 8.33) and an average education of 12.12 years (SD: 2.03). The major demographic characteristics of the overall sample can be found in Table 2.1.

The severity of the head trauma in all but two cases was determined on the basis of the initial GCS score obtained upon admission to hospital (3-8: severe; 9-12: moderate; 13-15: mild; Teasdale & Jennett, 1974). The two exceptions consisted of cases where the length of coma suggested a more severe head trauma than that indicated by the initial GCS score. One patient who had obtained an initial GCS score of 9 (moderate) but received a rating of 3 the next day and subsequently spent 23 days comatose was rated as severe. As well, another patient who initially received a rating of

Table 2.1. Demographic Data for the Overall Sample of TBI Patients.

	N	*M*	*SD*	Range
Age (years)	50	27.30	8.34	17.00-49.00
Education (years)	50	12.12	2.03	8.00-18.00
Sex (Male)	27			
(Female)	23			

moderate was classified as severe as he ultimately spent 21 days in coma. Other indices of severity of head injury included the PTA duration and coma length which were determined on the basis of a comprehensive review of each patient's medical chart at the time of his/her hospitalization.

At the time of injury, 10 subjects suffered a left-sided hemiparesis; 8 presented with a right-sided hemiparesis; and 1 suffered a severe bilateral hemiparesis with marked left-sided spasticity. Right homonymous hemianopia was present in three cases while left homonymous hemianopia was documented in two patients. These findings were primarily observed in severe TBI patients (n=20) with the exception of four moderate TBI patients who also experienced such physical deficits. At the time of follow-up, all participants were ambulant with the exception of two subjects who required the use of a wheelchair and one participant who made occasional use of a cane.

The postinjury neuropsychological evaluations were conducted an average of 8.50 months following the trauma (SD: 1.74; Range: 6.00-12.00). The follow-up evaluation was carried out an average length of 2.74 years postinjury (SD: 0.96; Range: 1.0-4.75). In 76% of cases, a parent, spouse, or boyfriend/girlfriend was asked to fill out the questionnaires designed for significant others (see Table 2.2). In the rest of cases, a sibling, child, or friend was chosen as the best person to fill out questionnaires on the TBI patient. At the time of follow-up, patients and significant others had known each other an average of 16.92 years (SD: 10.87).

Material

Materials used in the present study were of two types: i) neuropsychological data which had already been collected at the time of follow-up and ii) psychosocial measures that were filled out at the time of follow-up. The former data served, along with other variables to be listed under the Data Analysis section, as predictor variables while the latter constituted the criterion variables. In order to avoid any unnecessary replication or redundancy of neuropsychological data, only certain neuropsychological tests were selected. For instance, while two measures of verbal learning were available, only one of them was used. A list of all tests categorized according to the primary abilities that they measure (though many tests are multifactorial in nature) and the paramaters to be used in statistical analyses is presented below. A detailed

Table 2.2. Choice of a Significant Other for Completion of the Various Questionnaires.

Relation to Patient	Absolute Frequency	Relative Frequency (%)	Cumulative Frequency (%)
Spouse	17	34.0	34.0
Parent	15	30.0	64.0
Brother/Sister	6	12.0	76.0
Boyfriend/Girlfriend (live-in or not)	6	12.0	88.0
Child	2	4.0	92.0
Friend	4	8.0	100.0

description of each neuropsychological test is not provided as these tests are widely used. For some tests, scores were replaced by percentage values as the method of administration occasionally differed slightly from one setting to the next. For example, while modified versions of the Boston naming task were used in both settings from which the participants were obtained, one setting made use of 26 pictures while the other utilized 30 pictures. The score for this test was therefore expressed in terms of percentage of correct responses.

A. General Cognition

1. Wechsler Adult Intelligence Scale-Revised (Wechsler, 1981)

   predictors: -Verbal IQ
   -Performance IQ

2. L'Echelle d'Intelligence Ottawa-Wechsler (Chagnon, 1953; Chagnon, 1955)

   predictors: -Verbal IQ
   -Performance IQ

B. Memory

1. Wechsler Memory Scale (Wechsler, 1945)

   predictors: -Logical Memory Percentage
   -Visual Reproduction Percentage
   -Paired Associates Learning Task Percentage

2. California Verbal Learning Test (CVLT) (Delis, Kramer, Kaplan & Ober, 1987)

   predictors: -Total number of words recalled
   -Number of semantic categories used
   -Total percentage of decrement over time

C. Language

1. F-A-S Fluency Test (Benton & Hamsher, 1976; Benton, Hamsher, Varney & Spreen, 1983)

   predictor: -Total score

2. Animal Fluency Test (Rosen, 1980)

   predictor: -Total score

3. Modified Boston naming task (Kaplan, Goodglass, & Weintraub, 1989).

   predictor: -Total percentage of correct responses

D. Visual-Spatial Abilities

1. WAIS-R Block Design subtest

   predictor: -Scaled score

2. WAIS-R Object Assembly subtest

   predictor: -Scaled score

E. Attention

1. Trail-Making Test A (Reitan, 1958)

   predictors: -Overall time

2. Trail-Making Test B (Reitan, 1958)

   predictors: -Overall time

3. WAIS-R Digit Span subtest

   predictors: -Scaled score

4. WAIS-R Digit Symbol subtest

   predictor: -Scaled score

F. Motor Performance

1. Finger Oscillation Test (Reitan & Wolfson, 1985)

<u>predictors:</u> -Score with dominant hand
-Score with non-dominant hand

2. Hand Grip Strength (Reitan & Wolfson, 1985)

<u>predictors:</u> -Score with dominant hand
-Score with non-dominant hand

3. Grooved Pegboard (Klove, 1963; Matthews & Klove, 1964)

<u>predictors:</u> -Score with dominant hand
-Score with non-dominant hand

G. Executive/Frontal

1. Wisconsin Card Sorting Task (Berg, 1948; Grant & Berg, 1948)

<u>predictors:</u> -Number of categories achieved (Since one setting stopped the administration of the test after 6 categories had been achieved while the other administered all 128 cards regardless of performance, '7' was used as the highest number of categories achieved. This score was assigned to patients who obtained 6 categories with enough cards left over to complete another category (in the former setting) as well as to patients who had obtained 7 or more categories in the latter setting)
-Total number of Perseverative Responses in percentage (including perseverations to preceding categories or preceding responses. For example, if a subject perseverated to the previous category on 11 occasions and to the preceding response on 15 occasions, his perseverative percentage would be 20)

2. F-A-S Test

<u>predictor:</u> -Total Number of perseverations (defined as the same word repeated)

3. Animal Test

predictor: -Total number of perseverations
(defined as the same word repeated)

4. CVLT

Predictors: -Total number of perseverations
-Total number of intrusions

5. WAIS-R Similarities subtest

predictor: -Scaled score

6. WAIS-R Picture Arrangement subtest

predictor: -Scaled score

7. Trail-Making Test A & B

predictors: Number of errors

With respect to assessing psychosocial adjustment, it was deemed necessary to use several outcome measures because of the complexity of the concept under scrutiny. Information was gathered from two sources: i) the patient and a ii) close relative or friend. This was done in an effort to control for the biased accounts which may be offered by patients who may lack insight or by relatives who may give distorted accounts due to the high level of stress that they are experiencing (McKinlay & Brooks, 1984). It was also felt that information derived from two different sources would provide a more comprehensive picture of the patient's psychosocial functioning. A description of each measure follows. The English version of these scales can be found in Appendix B.

Sickness Impact Profile (Gilson et al., 1975; Bergner, Bobbitt, Pollard, Martin, & Gilson, 1976).

The Sickness Impact Profile (SIP) is a behaviorally-based measure which was designed to measure sickness-related changes in behavior. It relies solely on the individual's perception of the impact of sickness on his/her usual daily activities (Gilson et al., 1975). This scale consists of 136 items which are grouped into the following twelve categories or areas of activity: 1) ambulation, 2) mobility, 3) body care and movement, 4) social interaction, 5) communication, 6) alertness behavior, 7) emotional behavior, 8) sleep and rest, 9) eating, 10) work, 11) home management, and 12) recreation and pastimes. It can either be interviewer-administered or self-administered (the latter method was chosen for this study). The patient is asked to answer all items using his/her usual activity as the baseline. Consequently, this measure is primarily concerned with performance as opposed to capacity. As explained in an unpublished summary of the test's purpose, uses and administration ("Sickness Impact Profile", 1978), a score for each of the 12 categories can be obtained, as well as a Psychosocial score, Physical score and Overall score.

Several years of development and testing have been invested into the SIP. The initial work began in 1972 with the collection of statements describing sickness-related changes in behaviour. All of the items originally came from descriptions of dysfunction reported by individuals who were sick. Initially, 312 items were distributed among 14 categories. Three field trials conducted between 1973 and 1976 were used to revise and shorten the test to its current version (Gilson et al., 1975; Bergner, Bobbitt, Kressel, et al., 1976; Bergner, Bobbitt, Pollard, et al., 1976). A range of conditions was assessed by sampling the acutely and chronically ill, the elderly, and by testing patients with speech pathology, hyperthyroidism, rheumatoid arthritis, total hip replacement and rehabilitation problems.

The reliability of the individual categories and the instrument as a whole was demonstrated. Coefficients of test-retest reliability (ranging between .80 and .88), internal consistency, and validity have been well within acceptable limits for interviewer-administered and interviewer-delivered SIP (Gilson et al., 1975). Evidence of construct validity has been demonstrated by the ability of the SIP to differentiate and discriminate among subgroups in which prior assumptions regarding level of health status were made. It has shown sensitivity to change across time and sensitivity to differences among groups of subjects at both low and high levels of dysfunction. Indeed, Lamping (1985) described the SIP in the following terms:

> "...designed to be broadly applicable across a variety of treatment and diagnostic groups; sensitive to changes over time, especially to minimal levels of dysfunction, and to different conditions;... multidimensional; extensive reliability and validity data..." (p. 132).

The SIP has also been validated in terms of its relationship to other measures currently in use: subject's self-assessment of health status; clinician's assessment of the subject's health status, and scores obtained on other functional assessment instrument ("Sickness Impact Profile", 1978). In summary, the SIP is a measure that has been tested extensively and which possesses very complete guidelines for administration, ways of dealing with problems which may come up during testing, and ways of assessing test-retest reliability (Conn, Bobbitt, & Bergner, 1978). Good reliability and validity data are available (Bergner, Bobbitt, Carter & Gilson, 1981; Martin et al., 1976; Pollard, Bobbitt, Bergner, Martin & Gilson, 1976). Since its earlier days, it has been used with a variety of patient populations: chronic low back pain patients (Follick, Smith & Ahern, 1984); cardiac patients (Kolman et al., 1984); and TBI patients (Klonoff, Costa & Snow, 1986; Klonoff, Snow, & Costa, 1986).

For the purpose of the present research, the English and French versions of the SIP were used. Each profile was scored on the basis of the 12 functional areas as well as the three summary scores: Psychosocial, Physical, and Overall SIP.

Competency Rating Scale – Patient's Form (Prigatano et al., 1986).

This scale focuses on the patient's ability to perform a variety of everyday activities. It is a 30-item 5-point behavioral rating scale which is to be filled out by the patient. For the purpose of administration of the competency scale to patients in this study, the potentially threatening term 'competency' was replaced by the word 'functional'.

Unfortunately, to date, there does not seem to be any validity or reliability data available for the scale most likely due to its very recent status. Despite the lack of such data, the two scales used by Prigatano and his team were used in the present study because of i) their face validity, ii) ease of administration, and iii) direct comparison of the patient's and relative's responses that it provides.

Unlike the scoring suggested by its authors, the Competency Rating Scale (CRS) was scored with '1' indicating normal functioning and '5' applying in cases where patients cannot perform the activities. A cumulative score was obtained for each patient. This reverse scoring was instituted to ensure that all psychosocial measures were scored similarly: the higher the score, the greater the psychosocial maladjustment. Both the English and French versions of this test were used.

Competency Rating Scale - Relative's Form (Prigatano et al., 1986).

The same 30 items are rated by a relative or someone else who is familiar with the patient's functioning. Prigatano's rationale for asking another person to rate the patient's performance is that by obtaining a different perspective on the patient's level of functioning, it may be possible to highlight the level of awareness of the patient. Once again, reverse scoring for the CRS was used for the English and French version of this scale.

Katz Adjustment Scale - Relative's Form R1 and R2 (Katz & Lyerly, 1963).

The Katz Adjustment Scale-Relative's Form (KAS-R) has been used extensively with psychiatric populations since its publication in 1963. The scale was designed to measure objectively the adjustment and social behavior of patients in the community. The entire scale is made up of 205 items which are to be rated on a 4-point or 3-point scale, depending on the form, by a relative or anyone else who is familiar with the patient's behavior. It consists of five sections or forms that cover different areas of functioning: 1) symptoms and social behavior, 2) social performance, 3) relative's expectation of performance, 4) free-time activities, and 5) relative's satisfaction with performance of free-time activities. The scale only requires a sixth grade reading level (Weissman, 1975) and only requires 25 to 45 minutes for completion. Although it was originally designed for psychiatric populations, researchers have used it successfully with TBI populations (Fordyce, Roueche & Prigatano, 1983; Klonoff, Costa & Snow, 1986; Newton & Johnson, 1985; Prigatano et al., 1986). The present study will make use of Forms R1 and R2 only.

Form R1 (KAS-R1) deals specifically with the patient's symptomatology and social behavior. The collection of the 127 items that make up this form was based on a set of 12 hypothetical clusters: 1) belligerence, 2) verbal expansiveness, 3) negativism, 4) helplessness, 5) suspiciousness, 6) anxiety, 7) withdrawal and retardation, 8) general psychopathology, 9) nervousness, 10) confusion, 11) bizarreness, and 12) hyperactivity. Subsequent study highlighted a 13th cluster, 'stability' (Hogarty, Katz, & Chase, 1971).

Form R2 (KAS-R2) which focuses on the patient's level of performance in socially-expected abilities such as family and social responsibilities, social activities, self-care, home adjustment, and community activities, is made up of 16 items which are rated on a 3-point scale. The total score which is derived from summing the items is viewed as "a measure of the level or amount of socially expected activities in which the patient has been involved" (p. 514).

An initial validity study was carried out to determine the discriminative value of the scale with respect to different groups whose adjustment levels were known. For the purposes of the study, 15 well-adjusted ex-hospitalized patients and 15 marginally or poorly adjusted patients were compared. Results, based on correlational analyses, revealed a high degree of correlation between expectations based on clinical judgment and relative's report (values ranging between .79 and .67). The authors therefore concluded that the relatives' report successfully discriminated between the two groups.

The second phase of the validity study consisted of developing a scoring system for Form RI and deriving a set of empirical measures using a factor analytic method. The samples used consisted predominantly of schizophrenic patients from two different settings. Cluster analysis was performed on the 127 items. This cross-validation study highlighted the internal consistencies of the 12 clusters across samples (with coefficients ranging between .64 and .87 for one sample and between .41 and .81 for the second one). Finally, a mean absolute difference of .07 for the intercorrelations of clusters across the two samples documented the highly stable pattern of relationship among clusters.

To sum up, after important validity research, Katz and Lyerly (1963) conclude that "the scales are demonstrated to be highly discriminative and capable of closely appromixating expert clinical judgment..." (p. 532). Other reports have described the Katz Adjustment Scale as being an excellent assessment of the patient's participation and adjustment in the community (Weissman, 1975).

For the purposes of the present study, the KAS-R was scored in terms of the 12 clusters presented in the original publication (Katz & Lyerly, 1963) plus the one published in 1971 by Hogarty and associates for Form R1, and the Total Score for Form R2. The two Katz forms were used in the English and French (Manseau, 1988) versions.

Procedure

Initially, hospital records were reviewed to determine the eligibility of each TBI patient on the basis of the inclusion/exclusion criteria. An introductory letter, which can be found in Appendix C, was then sent to potential research subjects. Following contact with a participant, either via reception of his/her response card or via a telephone conversation, an appointment was scheduled for the follow-up assessment. However, in 14 cases where participants reported being unable to come to one of the two hospitals for follow-up, the questionnaires and consent forms were mailed to the patient's home address after an interview had been conducted over the phone. Results of multiple analyses of variance performed on the SIP subscales (F (12,48) = 1.33, p < .241), KAS-R1 (F (13,48) = 0.84, p < .905), and the Competency Rating Scales (F (2,48) = 1.61, p < .211) as well as one-way analyses of variance computed for the KAS-R2 (F (1,48) = 2.08, p < .156) and the SIP-Total Score ((F (1,48) = 1.14, p < .291) revealed no significant differences between those who had filled out the questionnaires at home and those who completed them in the presence of the examiner (see Appendix D for results of these analyses). These negative results, which are compatible with earlier reports concerning the use of postal questionnaires (Bruckner & Randle, 1972; Ebrahim, Nouri, & Barer, 1985), allowed all subsequent statistical analyses to be based on the overall sample.

Upon the arrival of those who were able to attend a follow-up evaluation, patients were interviewed with respect to the nature of their accident, length of hospitalization and subjective complaints at the time of assessment. They were then asked to sign four forms: i) consent form for participation in the study, ii) authorization form to release medical information, iii) authorization form giving the name of a significant other who would be asked to fill out questionnaires, and iv) Ontario Mental Health Act Form 14 for release of the neuropsychological data. They were subsequently presented with the SIP and the CRS-Patient's Form. These questionnaires were completed in the presence of the examiner and questions were entertained whenever patients were in doubt. Following this evaluation, an envelope containing the KAS Forms R1 and R2, the CRS-Relative's Form and a consent form was sent to the significant other either by mail or via the participant who had offered to hand-deliver the package. The various consent forms used with the participants and significant others can be found in Appendices E and F, respectively. The letter thanking the subjects for their participation, which was sent the week following the follow-up evaluation, and a summary of the results which was forwarded to the participants at the end of data collection appear in Appendices G and H, respectively.

Estimation of Missing Data. Since many statistical analyses require a complete data matrix, it was deemed necessary to provide estimates for missing data.

Neuropsychological Data. With respect to missing neuropsychological data, the mean value of the appropriate severity group,. i.e. mild, moderate, or severe, was substituted. As stated above, group membership was determined on the basis of the GCS score.

The appropriate group mean percentage values for the Naming task were substituted in three cases of severe TBI (mean value of 78) and one case of mild TBI (mean value of 95). The mean value of the severe group for the Animal Fluency Task replaced two missing values in that group (mean value=14) while the mean values of the severe group on Trail-Making A (mean value=68) and B (mean value=131) were substituted in two severe cases. The missing value of a severely TBI patient's WAIS-R Digit Symbol subtest was replaced by the appropriate group mean (value=6). Finally, the worse score obtained by any subject on Trail-Making B (highest score=445 seconds) was assigned to a severely head-injured patient who could not finish the task due to increased confusion.

Motor Tasks. For all motor tasks, missing values were replaced by the worst score obtained by a subject in the overall sample if the patient had been unable to perform due to central nervous damage related to the head injury. He/She was ascribed the worst score obtained to reflect the severity of the motor sequelae following the head injury. If, on the other hand, the task was simply not administered or could not be done due to a peripheral injury, the mean score of the overall sample was used.

In a moderate TBI patient, the appropriate mean values were substitued for all motor tasks performed with either hand due to the presence of rheumatoid arthritis. Three cases of severe TBI, for whom none of the motor values were available, were treated as follows: one received the worst scores for the preferred hand; another, the worst scores for the non-preferred hand; and the the third received substitution of mean values for the nonpreferred hand and worst scores for the preferred hand. The highest attainable score for the Grooved Pegboard task was assigned to three additional cases of severe TBI (for the dominant hand in two cases and for the nondominant hand in the other). Finally, the mean values of the Finger-Oscillation task were substituted for both hands in a severe TBI patient.

Indices of severity. Complete data were available on the indices of severity of TBI including GCS score, PTA duration and coma length.

Psychosocial Measures. The substitution of missing values on the psychosocial questionnaires was carried out in the patient's benefit, i.e., missing values were replaced by the lowest possible value, therefore suggesting good adjustment. All questionnaires filled out by patients were complete and only three respondants failed to provide answers to all questions. Two respondents, one from the severe group and the other from the moderate group, omitted one and two items respectively on the KAS-R1. A third respondent, belonging to the mild group, did not provide answers to five questions from the KAS-R1 and 10 items from the CRS. In all three cases, a value of '1' which means 'Almost never' on the KAS-R1 and 'Can do with ease' on the CRS replaced missing data.

Chapter III

RESULTS

In order of presentation, this chapter outlines the statistical analyses used in the present investigation, summarizes the epidemiological and neuropsychological characteristics of the overall sample and of the three severity groups of TBI patients, and finally, discusses the psychosocial adjustment of patients having suffered a TBI. Whenever data pertaining to the three different severity groups of head-injured patients will be described, comparison of performance of these groups will also be presented. Subsequently, the predictive value of the neuropsychological data and indices of severity of injury with respect to the psychosocial adjustment of the overall sample will be investigated. Finally, each hypothesis will be reviewed and supporting/contradictory data will be presented.

Data Analysis

All of the data gathered as part of this study were analyzed by way of the SPSS-X statistical package (SPSS-X, 1986). The epidemiological data of each group of patients were analyzed with a Chi Square analysis and one-way analyses of variance (ANOVAs). A comparison of the neuropsychological and psychosocial profile of mildly, moderately, and severely head-injured patients was carried out with multivariate analyses of variance (MANOVAs). In order to ensure an acceptable subject-variable ratio for the canonical correlations, factor analyses were performed on the neuropsychological and psychosocial data as well as on the indices of severity of head injury (PTA duration, coma length, and GCS score) to highlight the major underlying factors. As well, for some of the analyses, neuropsychological performance was expressed in terms of an Average Impairment Rating. Finally, the interrelationships between the multiple predictor variables (neuropsychological and severity factors as well as sex, age, education, and presence/absence of skull fracture) and multiple outcome parameters (represented by the psychosocial factors) were assessed with the help of canonical correlation analyses.

Epidemiological Characteristics

Total Sample

The overall sample was characterized by an average coma length of 14 days, PTA duration of 48.5 days, and GCS score of 8 (Table 3.1). As well, 72% of the overall sample was characterized by abnormal CT scan results taken at the time of admission. These values clearly indicate that the sample under investigation is characterized by patients who have suffered a severe head injury.

Forty-four percent of the sample pool suffered a skull fracture at the time of the head trauma while 94% lost consciousness. Only 22% of all subjects were under the influence of alcohol at the time of the accident. Of the 76% who have resumed drinking since the accident (many were advised to discontinue drinking due to the possible adverse effect of alcohol when combined with medications), 55% reported an increased susceptibility to the effect of alcohol.

As evidenced by the values presented in Table 3.2, the majority of patients (74%) suffered a head injury secondary to a motor vehicle accident while 16% did following a fall. At the time of follow-up, 40% of participants were involved in litigation. Only 20% of those ever involved in litigation had reached legal settlement by the time of this study.

TABLE 3.1. PTA Duration, Coma Length and GCS Score for the Overall Sample of TBI Patients.

	N	*M*	*SD*	Range
PTA: (days)	50	48.50	47.51	1.00-210.00
Coma: (days)	50	14.01	17.83	0.00-90.00
GCS Score:	50	8.12	3.58	3.00-15.00

Table 3.2. Cause of TBI (reported in percentages) in the Overall Sample of TBI Patients.

($\underline{N}$ = 50)

	Absolute Frequency	Relative Frequency	Cumulative Frequency
Car accident	26	52%	52%
Motorcycle	9	18%	70%
ATV	5	2%	72%
Snowmobile	1	2%	74%
Fall	8	16%	90%
Blow to the head	3	6%	96%
Pedestrian	1	2%	98%
Bicycle	1	2%	100%

Note. Table abbreviations: ATV=all terrain vehicle.

Group Differences

The mean age and education values at the time of injury as well as the distribution of sex among the three severity groups can be found in Table 3.3. The severe group averaged 27.03 years of age (*SD*: 7.12) and 11.97 (*SD*: 2.5) years of education. The moderate group was characterized by an average age of 25 years (*SD*: 10.38) and an education level of 12.46 (*SD*: 2.77) while the mild group averaged 30.44 years of age (*SD*: 9.42) and 13.44 years of education (*SD*: 1.67). One-way ANOVAs produced a non-significant F ratio for age at time of injury ($F(2,47) = 1.07$, $p = .350$) and a significant effect for education ($F(2,47) = 3.35$, $p = .044$). Paired comparisons using the Tukey's Honestly Significant Difference (HSD) at the 0.05 level revealed that the mildly impaired TBI patients had attained a significantly higher level of education at the time of injury than had the severe TBI patients.

The respective mean values of PTA duration, coma length, and GCS score at admission for the severe, moderate, and mild groups were as follows: 71.03 days, 22.23 days and 5.63; 16.45 days, 2.82 days and 10.46; and 12.56 days, 0.02 days and 13.56, respectively (Table 3.4). One-way ANOVAs revealed highly significant differences between groups for PTA duration ($F(2,47) = 12.38$, $p = .0000$), coma length

Table 3.3. Demographic Data for the Three Severity Groups of TBI Patients.

	n	M	SD	Range
Severe				
Age (years)	30	27.03	7.12	17.00-41.00
Education (years)	30	11.60	1.63	9.00-16.00
Sex (Male)	18			
(Female)	12			
Moderate				
Age (years)	11	25.00	10.38	17.00-49.00
Education (years)	11	12.46	2.77	8.00-18.00
Sex (Male)	7			
(Female)	4			
Mild				
Age (years)	9	30.44	9.42	17.00-45.00
Education (years)	9	13.44	1.67	11.00-16.00
Sex (Male)	2			
(Female)	7			

TABLE 3.4. PTA Duration (days), Coma Length (days) and GCS Score for the Three Severity Groups of TBI Patients.

	n	*M*	*SD*	Range
Severe				
PTA:	30	71.03	48.23	15.00-210.00
Coma:	30	22.23	18.93	1.00-90.00
GCS Score:	30	5.63	1.83	3.00-10.00
Moderate				
PTA:	11	16.45	12.72	1.00-44.00
Coma:	11	2.82	2.78	0.00-7.00
GCS Score:	11	10.46	1.29	9.00-12.00
Mild				
PTA:	9	12.56	20.43	1.00-63.00
Coma:	9	0.02	0.13	0.00-0.04
GCS Score:	9	13.56	0.73	13.00-15.00

($F(2,47) = 11.45$, $p = .0001$), and GCS score ($F(2,47) = 101.91$, $p = .0000$). Using the multiple-comparison method of Tukey's Honestly Significant Difference (HSD) at the 0.05 level, it was demonstrated that for coma and PTA duration, the severe group differed significantly from both the moderate and mild groups while significant differences between the severe group and the other two groups as well as between the moderate and mild groups were noted for the GCS scores.

Not surprisingly, in light of the significance of the between-group results concerning the different indices of severity, a one-way ANOVA performed on the severity factor (Table 3.5) which was derived through factor analysis in order to reduce the number of variables to be entered in the final canonical correlation analysis yielded highly significant results ($F(2,47) = 31.36$, $p = .0000$). Pairwise comparisons, based on Tukey's HSD, indicated that the severe group of TBI patients differed significantly from the other two groups of patients.

Nonparametric statistics using Chi Square analysis were performed on personal, medical, and social data. Results of such analyses only revealed significant differences with respect to one variable: CT scan results (Table 3.6). The

Table 3.5. Principal Components Analysis performed on the Severity Indices.

($\underline{N}$ = 50)

Final Statistics

Factor	Eigenvalue	Percentage of Variance
1	2.40424	80.1

Factor Matrix

Variables	Factors 1
Coma Length	.91719
GCS Score	.91144
PTA	-.85572

Note. Table abbreviations: GCS=Glasgow Coma Scale, and PTA=Posttraumatic amnesia.

Table 3.6. Group Comparisons of Epidemiological Data according to Severity of Head Injury (Severe, Moderate and Mild).

($\underline{N}$ = 50)

Variables	Chi Squares	Degrees of Freedom	p Values
Sex	4.50	2	.105
Handedness	1.39	2	.499
Language	2.24	2	.327
Skull Fracture	4.75	2	.093
Loss of Consciousness	0.98	2	.612
CT scan	18.31	4	.001
Alcohol at Injury	0.12	2	.940
Susceptibility to the effects of Alcohol	3.20	4	.525
Legal Involvement at any time	2.92	2	.233
Legal involvement at time of follow-up	0.95	2	.620
Cause of accident	17.35	14	.238

cell frequency distributions indicated that the more severe the injury, the more frequently the CT scan results were found to be abnormal (90% of severe TBI; 63.6% of moderate TBI; and only 22.2% of mild TBI patients).

While the majority of severe (63.3%) and mild (66.7%) TBI patients did not suffer a skull fracture at the time of their injury, the majority of moderate TBI patients (72.7%) did. More than 88% in all three groups lost consciousness at the time of the accident (96.7% of severe cases, 90.9% of moderate patients, and 88.9% of the mild group). Less than 24% of participants in all three groups were under the influence of alcohol at the time of their injury (23.3% in the severe group, 18.2% in the moderate group, and 22.2% in the mild group). Of those who have resumed drinking since the accident (73.3% in the severe group, 72.8% in the moderate group, and 88.9% in the mild group), varying percentages of patients reported an increased susceptibility to the effects of alcohol: 59% of severe patients, 37.5% of moderate patients, and 62.5% of mild patients.

As evidenced by the values presented in Table 3.7, the majority of severe (83.3%) and moderate (72.7%) TBI patients suffered a head injury secondary to a motor vehicle accident while only 44% of patients in the mild group did.

Table 3.7. Cause of TBI (in percentages) in the Three Severity Groups of TBI Patients.

	Type of TBI		
	Severe	Moderate	Mild
Car accident	53.3%	54.5%	44.4%
Motorcycle	26.7%	9.1%	0.0%
ATV	3.3%	0.0%	0.0%
Snowmobile	0.0%	9.1%	0.0%
Fall	10.0%	18.2%	33.3%
Blow to the head	0.0%	9.1%	22.2%
Pedestrian	3.3%	0.0%	0.0%
Bicycle	3.3%	0.0%	0.0%

Note. Table abbreviations: ATV=all terrain vehicle.

Following their injury, 56.7% of severe TBI cases and 55.6% of mild cases were involved in litigation in contrast to a 27.3% rate for the moderate group. At the time of follow-up, 13.4% of severe TBI patients and 11.2% of mild cases had reached legal settlement while none of the cases involving moderate TBI individuals had been settled.

In summary, the three severity groups were homogeneous with respect to age, sex, handedness, language spoken, loss of consciouness, alcohol intake at the time of injury, increased susceptibility to the effects of alcohol, past or present legal involvement, and cause of accident. The only significant differences between groups were found on variables related to the severity of the head injury (PTA duration, coma length, GCS score and CT scan abnormalities). As well, the severe TBI group differed significantly from the mild group with respect to its lower level of education achieved at the time of injury.

Neuropsychological Data

Total Sample

The neuropsychological profile of the entire sample of participants can be found in Table 3.8. The tests are presented in the same order in which they appeared in Chapter II. Note that some of the parameters presented in

Table 3.8. Neuropsychological Profile of the Overall Sample

(N = 50)

Tests	Mean	SD	Range
Cognition			
Full Scale IQ	92.00	10.90	68.00-114.00
Verbal IQ	94.70	11.63	67.00-123.00
Performance IQ	90.88	12.46	59.00-114.00
Memory			
Wechsler MQ	95.00	16.21	59.00-140.00
WMS Stories (%)	34.30	13.30	7.00- 61.00
WMS Designs (%)	77.54	19.65	21.00-100.00
WMS PALT (%)	65.92	21.80	21.00-100.00
CVLT-Total Number of Words	46.14	13.50	6.00- 70.00
CVLT-Semantic Clustering	13.90	9.52	0.00- 41.00
CVLT-Total decay	15.36	34.68	-133.00-100.00
Language			
F-A-S Fluency	30.06	9.60	7.00- 48.00
Animal Fluency	16.14	5.62	5.00- 27.00
Naming Task (%)	83.34	13.64	37.00-100.00
Visual-spatial			
Block Design	9.20	2.47	4.00- 14.00
Object Assembly	8.64	2.95	1.00- 14.00
Attention			
Digit Span	8.94	2.59	4.00- 16.00
Digit Symbol	7.08	2.78	1.00- 14.00
Trail-Making A (Time)	52.96	52.43	17.00-361.00
Trail-Making B (Time)	105.50	86.05	30.00-445.00

Table 3.8. (Continued) Neuropsychological Profile of the Overall Sample

(N = 50)

Tests	Mean	SD	Range
Motor Performance			
Finger Tapping			
Preferred	40.68	11.02	14.00- 55.00
Nonpreferred	37.70	7.93	15.00- 49.00
Dynamometer			
Preferred	29.38	13.53	8.00- 61.00
Nonpreferred	29.12	13.06	3.00- 59.00
Grooved Pegboard			
Preferred	106.24	87.61	52.00-340.00
Nonpreferred	98.12	37.22	48.00-187.00
Executive/Frontal			
WCST- Categories	5.26	1.87	0.00- 7.00
WCST-Perseverations (%)	22.28	13.13	7.00-58.00
Similarities	10.02	3.14	5.00-17.00
Picture Arrangement	8.58	2.73	4.00-17.00
CVLT-Perseverations	4.46	4.17	0.00-16.00
CVLT-Intrusions	1.10	2.87	0.00- 9.00
Word Fluency Perseverations	0.72	1.20	0.00- 4.00
Animal Fluency Perseverations	0.28	0.73	0.00- 4.00
Trail A -Errors	0.13	0.43	0.00- 2.00
Trail B -Errors	0.63	0.89	0.00- 3.00

Note. Table abbreviations: IQ=Intelligence Quotient, MQ=Memory Quotient, PALT=Paired Associates Learning Task, CVLT=California Verbal Learning Task, and WCST=Wisconsin Card Sorting Task.

this table were not used in the factor analytic procedures but are nevertheless presented here in order to give a more comprehensive picture of the neuropsychological profile of the overall sample. While most mean values fell within normal limits, those obtained on tests of verbal memory, complex attention (Trail-Making Test), naming, and fine manipulative skills (Grooved Pegboard) were lower than those generally found in a normal population.

Average Impairment Rating The magnitude of the neuropsychological impairment of each patient was further estimated by calculating an Average Impairment Rating (AIR). This measure constitutes a summary index which is based on the average value of a number of neuropsychological tests expressed in standard deviation units (Rennick, cited in Russell, Neuringer, & Goldstein, 1970). Each neuropsychological profile was scored according to a 6-point scale (0-5) with 0 indicating a performance better than average; 1 equating normal functioning; and 2 to 5 representing mild, moderate, severe, and very severe impairment. The measures which were used to determine the AIR consisted of the WAIS-R Verbal and Performance IQs, Digit Span, Similarities, Picture Arrangement, Block Design, Object Assembly, and Digit Symbol; WMS Memory Quotient; CVLT total mumber of words recalled; letter and semantic fluency; Trail-Making Test A and B; number of categories achieved on the WCST; and dominant finger oscillation, hand dynamometer and grooved pegboard. These tests were scored on the basis of published norms (Bornstein, 1985; Borod, Goodglass, & Kaplan, 1980; Delis, Kramer, Kaplan, & Ober, 1987; Fromm-Auch & Yeudall, 1983; Heaton, 1981; Hulicka, 1966; Wechsler, 1981; Wechsler & Stone, 1974).

The mean AIR of the entire sample was of 1.62 with a standard deviation of 0.60 (Range: 0.72-3.11). This mean value falls within the mildly impaired range.

Group Differences

Table 3.9 lists the descriptive statistics of the neuropsychological test battery for all three groups of TBI patients: mild, moderate, and severe. At first glance, the severe group appears to have performed worse than the other two groups on tasks of general cognition, memory, language, visual-spatial skills, and attention. An analysis of the magnitude of the general cognitive impairment suffered as a result of the TBI, by way of subtracting the measured FSIQ from a predicted IQ calculated on the basis of education (see Karzmark, Heaton, Grant, & Matthews, 1985), indicated

Table 3.9. Neuropsychological Profile of Groups by Severity of TBI.

	Severity of TBI					
	Mild (n = 9)		Moderate (n = 11)		Severe (n = 30)	
Tests	M	SD	M	SD	M	SD
Cognition						
Full Scale IQ	96.22	6.16	101.18	10.04	87.37	9.79
Verbal IQ	99.33	6.46	102.73	12.66	90.37	10.55
Performance IQ	94.11	10.51	100.46	10.42	86.40	11.66
Memory						
Wechsler MQ	107.89	17.16	99.36	15.79	89.53	13.68
WMS Stories (%)	36.00	9.33	38.64	17.75	32.20	12.39
WMS Designs (%)	79.00	13.13	85.73	17.34	74.10	21.50
WMS PALT (%)	78.44	18.70	79.55	13.28	57.17	21.15
CVLT-Total Number of Words	56.78	6.67	53.36	13.05	40.30	12.11
CVLT-Semantic Clustering	21.00	8.65	16.09	12.01	10.07	7.51
CVLT-Total decay	6.89	15.42	15.55	17.11	17.83	42.86
Language						
F-A-S Fluency	37.67	4.92	32.27	9.54	26.97	9.37
Animal Fluency	19.56	4.88	18.91	5.79	14.10	4.94
Naming Task (%)	93.44	6.50	88.55	7.78	78.40	14.66
Visual-spatial						
Block Design	9.33	3.12	11.00	1.95	8.50	2.13
Object Assembly	8.56	1.74	10.36	2.77	8.03	3.12
Attention						
Digit Span	10.33	2.78	9.55	2.02	8.30	2.58
Digit Symbol	9.22	2.86	8.36	2.73	5.97	2.22
Trail-Making A	27.33	6.73	36.09	14.75	66.83	63.61
Trail-Making B	57.44	16.63	72.27	25.31	132.10	101.72

Table 3.9. (Continued) Neuropsychological Profile of Groups by Severity of TBI.

	Severity of TBI					
	Mild (*n* = 9)		Moderate (*n* = 11)		Severe (*n* = 30)	
Tests	***M***	***SD***	***M***	***SD***	***M***	***SD***
Motor Performance						
Finger Tapping						
Preferred	46.78	7.93	44.55	8.90	37.43	11.50
Nonpreferred	41.11	5.47	40.73	4.43	35.57	8.92
Dynamometer						
Preferred	29.11	9.06	36.18	15.59	26.97	13.40
Nonpreferred	24.56	7.49	34.18	12.82	28.63	14.13
Grooved Pegboard						
Preferred	61.11	8.87	80.91	59.74	129.07	101.50
Nonpreferred	68.00	12.41	76.73	14.79	115.00	38.38
Executive/Frontal						
WCST- Categories	6.22	1.20	5.27	1.95	4.97	1.96
WCST-Perseverations (%)	17.78	8.42	23.27	18.82	23.27	11.92
Similarities	11.67	2.74	11.82	3.06	8.87	2.81
Picture Arrangement	8.44	3.21	10.00	3.07	8.10	2.35
CVLT-Perseverations	5.22	4.84	3.91	2.12	4.43	4.59
CVLT-Intrusions	1.00	1.80	1.73	2.57	2.73	3.15
Word Fluency Perseverations	1.33	1.50	0.91	1.04	0.47	1.11
Animal Fluency Perseverations	0.33	0.71	0.09	0.30	0.33	0.84
Trail A - Errors	0.00	0.00	0.00	0.00	0.13	0.43
Trail B - Errors	0.00	0.00	0.09	0.30	0.63	0.89

Note. Table abbreviations: IQ=Intelligence Quotient, MQ= Memory Quotient, PALT=Paired Associates Learning Task, CVLT= California Verbal Learning Task, and WCST=Wisconsin Card Sorting Task.

that the severe group suffered a significantly greater loss than the moderate group only ($F(2,47) = 8.06$, $p = .001$). The measured and predicted FSIQ of the overall group and of each severity group can be found in Table 3.10.

While the severe group obtained lower mean scores on tasks of motor speed, the results were variable for hand grip strength and were dependent upon the hand tested. On tasks considered to be sensitive to executive functions, the severe group fared worse with respect to the Similarities and Picture Arrangement subtests of the WAIS-R, the number of intrusions produced on the CVLT, the number of categories achieved on the WCST, and the number of errors made on the Trail-Making Test A and B.

A linear trend of increased neuropsychological impairment with increase in severity of TBI was seen on the Wechsler Memory Scale-Memory Quotient, all parameters derived from the California Verbal Learning Task, all language and attentional tests, and motor speed tests. However, when the level of performance between groups was evaluated statistically using Wilk's criterion in a one-way MANOVA, the overall severity effect was found to be nonsignificant ($p = .497$). Table 3.11 contains the results of this MANOVA procedure. Scrutiny of the univariate F Tests reveals the presence of group effect on tests of

Table 3.10. Predicted and Estimated Full Scale IQ for the Overall Group and All Three Severity Groups of TBI Patients.

	Predicted FSIQ	Measured FSIQ	Difference
OVERALL (_N_=50)	110.79 (4.26)	92.00 (10.90)	18.79 (9.74)
Severe (_n_=30)	109.70 (3.43)	87.37 (9.79)	22.33 (8.50)
Moderate (_n_=11)	111.50 (5.82)	101.18 (10.04)	10.31 (8.85)
Mild (_n_=9)	113.57 (3.50)	96.22 (6.16)	17.35 (8.53)

Table 3.11. One-way MANOVA Procedure on Select Neuropsychological Variables of Groups based on Severity of TBI.

($\underline{N}$ = 50)

Multivariate F Test

Test Name	Value	Approx. F	Hypoth DF	Error DF	Sig. of F
Wilks	.10772	1.02340	64.00	32.00	.484

Univariate F Tests (2,47)

Variables	F Value	p Value	Tukey's HDS
Verbal IQ	6.67211	.003	Sev. < Mod.
Similarities	6.12657	.004	Sev. < both
Word Fluency	5.54600	.007	Sev. < Mild
Animal Fluency	5.99387	.005	Sev. < both
Naming Task	6.38625	.004	Sev. < Mild
WMS Stories	1.03420	.363	
WMS PALT	7.71116	.001	Sev. < both
CVLT-Total	9.73751	.000	Sev. < both
CVLT-Clusters	4.88827	.012	Sev. < Mild
CVLT-Decay	0.33564	.717	
WMS Designs	1.46757	.241	
Performance IQ	6.78113	.003	Sev. < Mild
Block Design	4.79495	.013	Sev. < Mod.
Object Assembly	2.68145	.079	
Digit Span	2.69171	.078	
Digit Symbol	8.02066	.001	Sev. < both
Trail A (time)	2.90412	.065	
Trail B (time)	4.12258	.022	Sev. < Mild
WCST-Categories	1.59626	.213	
WCST-Perseverations	0.63529	.534	
CVLT-Perseverations	0.23919	.788	
CVLT-Intrusions	1.48102	.238	
F-A-S-Perseverations	2.08230	.136	
Animal-Perseverations	0.46332	.632	
Trail A-Total Errors	0.91707	.407	
Trail B-Total Errors	4.05933	.024	n.s.
Finger-Tapping Preferred	3.73474	.031	n.s.
Finger-Tapping Non-Preferred	2.93114	.063	
Grip strength Preferred	1.93943	.155	
Grip strength Non-Preferred	1.42111	.252	
Pegboard Preferred	2.87659	.066	
Pegboard Non-Preferred	11.07522	.000	Sev. < both

verbal abilities (VIQ, Similarities, Letter and Animal Fluency, and naming), verbal memory (CVLT-Total, WMS-PALT and number of semantic clusters on CVLT), visual-spatial skills (PIQ and Block Design), complex attention and flexibility (Trail B total time and number of errors, and Digit Symbol), and motor speed (finger oscillation and grooved pegboard). On all tests where a univariate F was found to be significant with the exception of Trail B-Errors and dominant finger-tapping, the results of pairwise comparisons revealed the severe group to perform significantly worse than one or both groups. This pattern of results was essentially identical to that obtained when education was partialled out in a multivariate analysis of covariance (MANCOVA) (p=.417) with the minor exception of the Letter Fluency and Naming tasks for which the univariate F values were no longer significant.

Scrutiny of the data presented in Table 3.9 highlights two unexpected findings. On one hand, the moderate TBI group performed slightly better than the mild group on certain measures (WAIS-R Full Scale, Verbal and Performance IQs, Block Design, Object Assembly, Picture Arrangement, Similarities, and individual components of the WMS). These differences, however, were not found to be statistically significant. Secondly, the moderate and severe TBI patients performed worse with their preferred hand on a task of fine manipulative skills while the severe patients were also manually weaker with their preferred hand. These results suggest that localized left-hemispheric damage may have occurred in these patients.

Average Impairment Rating As illustrated in Table 3.12, when the neuropsychological performance of each group of patients was evaluated using the AIR, the following mean values were obtained: 1.92 (*SD*: 0.54), 1.27 (*SD*: 0.41), and 1.05 (*SD*: 0.25) for the severe, moderate, and mild TBI groups, respectively. A one-way ANOVA revealed highly significant results (F (2,47) = 15.51, p < .0000) with the severe patients having a significantly more elevated AIR than the other two groups.

Factor Analysis

A Principal Components Analysis (PCA) with varimax rotation was performed on the neuropsychological data from the overall sample. This procedure was used to explore the data and redefine them in terms of the underlying constructs which were then used in the canonical correlation analyses. As can be seen from the data presented in Table 3.13, the

Table 3.12. Average Impairment Rating (AIR) of the Three Severity Groups of Patients.

(N = 50)

	n	M	SD	Range
Severe				
AIR	30	1.92	0.54	1.11-3.11
Moderate				
AIR	11	1.27	0.41	0.83-2.06
Mild				
AIR	9	1.05	0.25	0.72-1.39

Table 3.13. PCA with Varimax Rotation performed on the Neuropsychological Data

Final Statistics

Factor	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	9.14743	28.6	28.6
2	3.67421	11.5	40.1
3	2.43945	7.6	47.7
4	2.14261	6.7	54.4
5	1.84197	5.8	60.1
6	1.61250	5.0	65.2
7	1.42083	4.4	69.6
8	1.18672	3.7	73.3

Varimax Rotated Factor Matrix

	Factors							
Tests	1	2	3	4	5	6	7	8
Verbal IQ	.85238							
CVLT-Total	.77294							
F-A-S Fluency	.74604							
Similarities	.73216							
Naming task	.58636							
Animal Fluency	.57029							
WMS-PALT	.56828							
CVLT-Clusters	.54800							
WMS-Stories	.49920							
F-T preferred		.88140						
Pegboard preferred		-.85371						
Digit Symbol		.57297						
Block Design			.77835					
Performance IQ			.71411					
WMS-Designs			.71155					
Object Assembly			.60739					
Trail A-Errors				.73204				
CVLT-Total Decay				.68481				
Trail A - Time				.59606				
Trail B - Time				.58157				
Animal-Perseverations					.77746			
FAS-Perseverations					.69250			
CVLT-Perseverations					.56171			
WCST-Categories						.91947		
WCST-Perseverations						-.77981		
Trail B - Errors						-.42546		
Non-preferred Grip Strength							.85894	
Preferred Grip Strength							.82321	
FT - Non-preferred								.82593
Pegboard - Non-preferred								-.80728

Note. Table abbreviations: F-T=Finger-tapping.

resultant eight factors accounted for 73.3% of the total variance. While nine factors were originally derived when an eigenvalue of 1.0 or greater was used as the selection criterion, analysis of the screeplot suggested that eight factors were sufficient to explain the data and were labelled as follows:

Factor 1. **Verbal abilities**

Loadings greater than .7 were obtained on the Verbal IQ, CVLT-Total, F-A-S Fluency Task, and Similarities subtest. More modest loadings (>= .5) were also obtained on the Naming Task, the Animal Fluency Task, the WMS-Paired Associates Learning task, and the CVLT-Semantic Clustering measure.

Factor 2. **Motor Speed-Preferred hand**

Significant loadings (>= .7) were obtained on the preferred Finger-Tapping and Grooved Pegboard measures. As well, Digit Symbol (with a loading of .57), which also contains an element of speed, loaded on this factor.

Factor 3. **Visual-Spatial skills**

Block Design, Object Assembly, and WMS-Visual Reproductions loaded significantly on this factor. Moreover, Object Assembly loaded modestly (loading = .61) on this factor.

Factor 4. **Long-term Memory and Complex Attention**

Trail-Making A and B with loadings of .60 and .58 respectively and CVLT Long-term Decay in Memory (loading = .73) were related to this factor.

Factor 5. **Perseverative tendencies**

Perseverations on the Animal Fluency Task (loading = .78), the F-A-S Task (loading = .69) and on the CVLT (loading = .56) determined the significance of this factor.

Factor 6. **Mental Flexibility**

The total number of categories (loading = .92) and perseverations (loading = -.78) on the WSCT loaded significantly on this factor.

Factor 7. **Manual Strength**

Significant loadings (> .80) were obtained on both measures obtained with the dynamometer.

Factor 8. **Non-dominant Motor Speed**

Finger-tapping speed and fine manipulative skills (Grooved Pegboard) for the non-preferred hand loaded significantly (> .80) on this factor.

In contrast to the nonsignificant group effect found when a one-way MANOVA was performed on the neuropsychological raw scores, a similar analysis carried out on the neuropsychological factor scores revealed a significant severity effect (p = .002). Table 3.14 contains the results of this analysis. Univariate F Tests (2,47) demonstrated that Factors 1 and 2 contributed to the overall severity effect. These factors correspond to the dimensions of verbal abilities and dominant motor speed. Pairwise comparisons were executed using Tukey's HSD on the neuropsychological factors with a significant univariate F value. These analyses revealed the severe group to fare worse than both groups on Factor 1 and worse then the Mild group on Factor 2. The results remained highly significant and essentially the same when education was partialled out with a MANCOVA (p = .009).

Psychosocial Adjustment

Total Sample

Psychosocial adjustment was measured by the use of five different scales: the SIP, the CRS-Patient's Form, the CRS-Relative's Form, and the Katz Adjustment Scale Form R1 and Form 2. As well, information concerning the primary areas of concern to the patients was gathered during the initial interview with the use of an open-ended question. Before discussing the results of the psychosocial scales, a brief summary of the patients' spontaneous complaints will

Table 3.14 One-way MANOVA Procedure on the eight Neuropsychological Factors of Groups based on Severity of TBI.

(N = 50)

Multivariate F Test

Test Name	Value	Approx. F	Hypoth DF	Error DF	Sig. of F
Wilks	.41855	2.72848	16.00	80.00	.002

Univariate F Tests (2,47)

Variables	F Value	Sig. of F	Tukey's HDS
Neuropsych. Factor 1	7.48506	.002	Severe < both
Neuropsych. Factor 2	3.47987	.039	Severe < Mild
Neuropsych. Factor 3	2.18466	.124	
Neuropsych. Factor 4	0.25598	.775	
Neuropsych. Factor 5	0.06124	.941	
Neuropsych. Factor 6	1.41248	.254	
Neuropsych. Factor 7	1.49013	.236	
Neuropsych. Factor 8	2.04028	.141	

now be presented. The complaint most commonly voiced among all patients was that of a loss of friendships since the accident as 62% of the sample voiced this. Sixty percent of all participants identified memory problems as another major area of concern. Thirty percent reported decreased stamina, lack of physical endurance, or increased fatigue. Finally, 22% reported personality changes such as increased irritability, mood changes, and lack of patience.

Descriptive statistics of the SIP subscales and composite scores (Physical, Psychosocial, and Total) for the overall sample are tabulated in Table 3.15. The variability noted on each scale is worth mentioning (i.e., the standard deviations were either greater or similar in size to the actual mean scores). Nevertheless, elevations were noted particularly on the psychosocial subscales (Emotional Behaviour, Social Interaction, Alertness Behaviour, Communication, Work, and Recreation and Pastimes) and on scales related to basic life activities (Sleep, Rest, and Home Management). The higher elevations on the psychosocial measures is further evidenced by the relatively higher Psychosocial score. Indeed, a paired samples t-test performed on the SIP Physical score and SIP Psychosocial score was found to yield significant results indicative of

Table 3.15. Sickness Impact Profile (SIP) Scores of the Overall Sample.

(N = 50)

Subscale	Mean	SD	Range
Sleep and Rest Activity	20.75	23.21	0.00-100.00
Emotional Behaviour	18.71	19.63	0.00- 81.40
Body Care & Movement	5.32	6.38	0.00- 24.90
Home Management	10.75	17.31	0.00-100.00
Mobility	6.46	12.30	0.00- 61.80
Social Interaction	18.63	18.17	0.00- 87.50
Ambulation	8.20	11.36	0.00- 46.80
Alertness Behaviour	35.78	31.30	0.00-100.00
Communication	11.80	13.56	0.00- 55.60
Work	37.01	31.74	0.00- 70.10
Recreation and Pastimes	25.71	21.95	0.00- 61.90
Eating	1.81	3.43	0.00- 13.60
Physical	6.67	8.08	0.00- 31.37
Psychosocial	21.08	16.91	0.00- 68.03
Total SIP	14.49	10.55	0.00- 43.03

overall greater psychosocial maladjustment ($t(49) = -7.10$, $p < .000$).

Table 3.16 contains descriptive statistics of the KATZ Adjustment Scale Form R1 and Form 2. When compared to the appropriate normative sample (Hogarty, Katz & Chase, 1971), it became apparent that the relatives of TBI patients described them as experiencing more maladjustment in daily life and more psychopathology on all dimensions of the Form R1 and Form R2 as all mean scores fell at least one standard deviation above the respective normative age group (all t tests results being significant at the .001 level for Form R1 and at the .01 for Form R2). In contrast, however, the mean scores for the TBI patients closely resembled those of a psychiatric population on many of the dimensions of Form R1 and Form R2 (Hogarty, Katz, & Chase, 1971). Nevertheless, some differences remained as the TBI patients were reported as being significantly more belligerent ($t(181) = 4.57$, $p < .001$) and more verbally expansive ($t(181) = 3.17$, $p < .001$) though less helpless ($t(181) = 2.77$, $p < .01$), anxious ($t(181) = 5.05$, $p < .001$), or nervous ($t(181) = 6.08$, $p < .001$). Finally, relatives also suggested that TBI patients engaged in more socially expected activities ($t(181) = 7.39$, $p < .001$) than psychiatric patients.

Table 3.16. Katz Adjustment Scale Form R1 and Form R2 Profile Scores of the Overall Sample.

(N = 50)

Subscale	Mean	SD	Range
Form R1			
Belligerence	7.04	2.67	4.00-16.00
Expansiveness	8.36	2.97	5.00-17.00
Negativism	16.82	5.45	10.00-32.00
Helplessness	7.14	2.59	4.00-14.00
Suspiciousness	6.68	2.83	4.00-16.00
Anxiety	7.90	2.57	6.00-16.00
Withdrawal & Retardation	12.02	3.71	6.00-22.00
General Psychopathology	44.68	11.21	26.00-81.00
Nervousness	8.24	2.62	4.00-16.00
Confusion	4.00	1.18	3.00- 8.00
Bizarreness	6.46	1.63	5.00-11.00
Hyperactivity	6.12	2.20	3.00-11.00
Stability	17.82	5.27	9.00-30.00
Form R2			
Socially-Expected Activities	26.64	5.51	18.00-38.00

Finally, the descriptive statistics of the two Competency Rating Scales are presented in Table 3.17. While the mean values of the two scales seem comparable and suggest only a slightly more elevated score on the Relative's Form, a paired samples t-test performed on the two versions revealed a significantly higher endorsement of items indicative of maladjustment by relatives than by patients ($\underline{t}(49) = -3.57$, $\underline{p} < .001$).

Group Differences

Descriptive statistics of the SIP, Katz Adjustment Scale Form R1 and Form R2 and Competency Rating Scales are summarized in Tables 3.18 to 3.20, respectively. The severe group achieved higher scores on the Competency Rating Scale-Relatives Form and all subscales of the SIP with the exception of the Emotional Behaviour subscale on which they rated themselves as being less maladjusted than the other two groups. As well, when asked to rate their level of functioning on the Competency Rating Scale, they rated themselves less impaired than the moderate TBI group did. Finally, the severe group fared worse on all scales of the Katz Adjustment Scale Form R1 and Form 2 with the exception of the Negativism, Helplessness, and General Psychopathology clusters. The SIP profile of each group can be found in

Table 3.17. Competency Rating Scale Scores for the Overall Sample.

($\underline{N}$ = 50)

Subscale	Mean	SD	Range
Competency Rating Scale Patients' Form	61.86	19.10	30.00-106.00
Competency Rating Scale Relatives' Form	70.42	20.49	32.00-110.00

Table 3.18. Sickness Impact Profile (SIP) Scores of the Three Severity Groups of Patients.

(N = 50)

	Severity of Injury					
	Mild		Moderate		Severe	
	(n=9)		(n=11)		(n=30)	
Subscale	M	SD	M	SD	M	SD
Sleep/Rest	17.80	31.37	18.67	18.53	22.40	22.66
Emotional Beh.	21.34	30.10	22.08	15.40	16.69	17.56
Body C & M	2.77	3.16	4.06	4.97	6.55	7.31
Home Management	4.12	10.13	9.28	11.31	13.27	20.32
Mobility	3.11	9.33	3.62	7.70	8.51	14.15
Social Inter.	17.19	28.58	14.70	13.51	20.51	16.10
Ambulation	3.39	4.46	4.49	9.18	11.00	12.77
Alertness Beh.	23.30	35.69	36.34	21.82	39.33	29.51
Communication	3.76	8.11	13.25	14.57	13.69	13.95
Work	16.41	23.91	25.36	31.87	47.47	29.96
Recreation & P	17.74	20.64	18.18	18.65	30.86	22.54
Eating	1.51	4.53	0.48	1.60	2.39	3.50
Physical	2.98	3.53	4.08	6.17	8.74	9.09
Psychosocial	16.75	21.82	20.98	15.60	22.41	16.13
Total SIP	10.02	13.14	12.75	8.72	16.46	10.14

Note. Table abbreviations: Beh.=Behaviour, C & M=Care and Movement, Inter.=Interaction, P=Pastimes, and SIP=Sickness Impact Profile.

Table 3.19. Katz Adjustment Scale Form R1 and Form R2 Profile Scores of the Three Severity Groups.

($\underline{N}$ = 50)

	Severity of Injury					
	Mild		Moderate		Severe	
	($\underline{n}$=9)		($\underline{n}$=11)		($\underline{n}$=30)	
Subscale	$\underline{M}$	$\underline{SD}$	$\underline{M}$	$\underline{SD}$	$\underline{M}$	$\underline{SD}$
Form R1						
Belligerence	6.00	1.50	7.18	2.18	7.30	3.06
Expansiveness	8.00	3.04	7.73	2.72	8.70	3.08
Negativeness	14.22	3.96	18.18	6.11	17.10	5.49
Helplessness	5.67	2.50	7.73	2.76	7.37	2.47
Suspiciousness	6.22	2.05	7.00	3.13	6.70	2.98
Anxiety	7.67	2.60	8.09	2.66	7.90	2.62
Withdrawal	9.56	2.96	11.64	4.59	12.90	3.28
Psychopathology	37.33	8.25	46.73	10.41	46.13	11.65
Nervousness	8.33	2.60	7.55	2.16	8.47	2.80
Confusion	3.67	0.87	3.64	0.92	4.23	1.31
Bizarreness	6.00	1.00	6.46	1.57	6.60	1.81
Hyperactivity	5.44	1.74	5.36	1.36	6.60	2.46
Stability	14.11	3.86	18.18	7.18	18.80	4.44
Form R2						
Socially-Expected Activities	21.78	3.38	26.82	5.02	28.03	5.49

Table 3.20. Competency Rating Scale Scores for the Three Severity Groups.

(N = 50)

	Severity of Injury					
	Mild		Moderate		Severe	
	(n=9)		(n=11)		(n=30)	
Subscale	M	SD	M	SD	M	SD
Competency RS						
Patients' Form	54.33	20.73	65.18	22.59	62.90	17.29
Competency RS						
Relatives' Form	55.11	21.12	70.73	19.55	74.90	18.99

Figure 3.1 while the Katz Adjustment Scale Profile is depicted in Figure 3.2.

A one-way MANOVA (Table 3.21), using Wilk's criterion, performed on the SIP revealed that the psychosocial adjustment of mild, moderate, and severe TBI patients did not differ significantly (F = 0.54, p < .388). Similarly, the univariate F-tests failed to document any significant differences between any of the subscales with the exception of the Work subscale. Pairwise comparisons carried out on this scale revealed the severe group to experience significantly more work-related dysfunction (p < .05) than the mild group. The results were again identical when education was partialled out with a MANCOVA (p=.731). Finally, a separate one-way ANOVA performed on the SIP Total score yielded nonsignificant results (p < .231). Paired-sample t-tests performed on the SIP Physical and Psychosocial scores revealed significant differences at the .006 level for the severe (t(29) = −5.90) and moderate (t(10) = −3.51) groups, indicating greater psychosocial maladjustment. For the mild group (t(8) = −2.22, p < .057), results approached significance with psychosocial maladjustment being rated as more severe.

When the profile of each group on the Katz Adjustment Scale Form R1 was analyzed statistically (see Table 3.22),

Figure 3.1

SIP Mean Scores of the Three Severity Groups

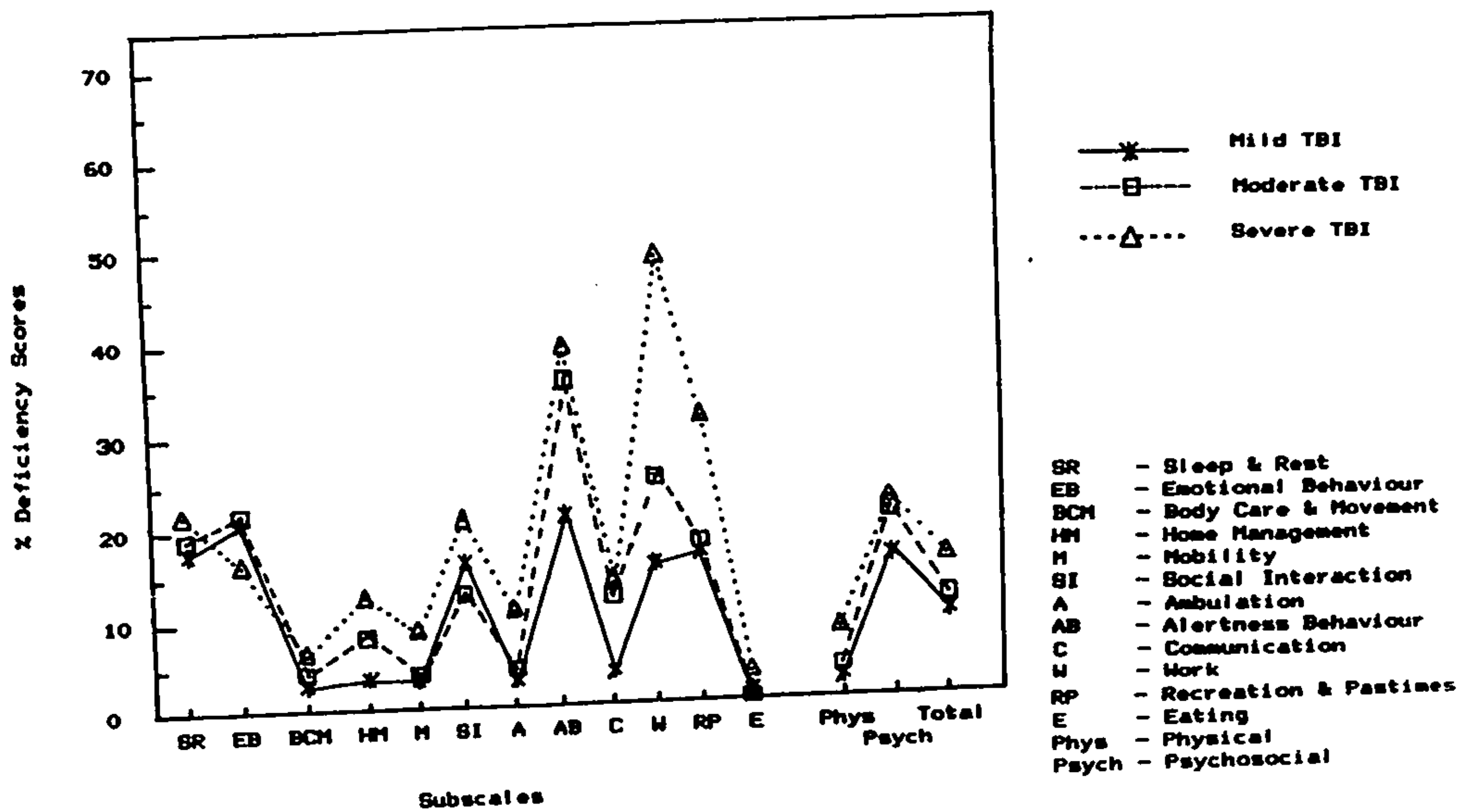

Figure 3.2

Katz Adjustment Scale Mean Scores of the Three Severity Groups

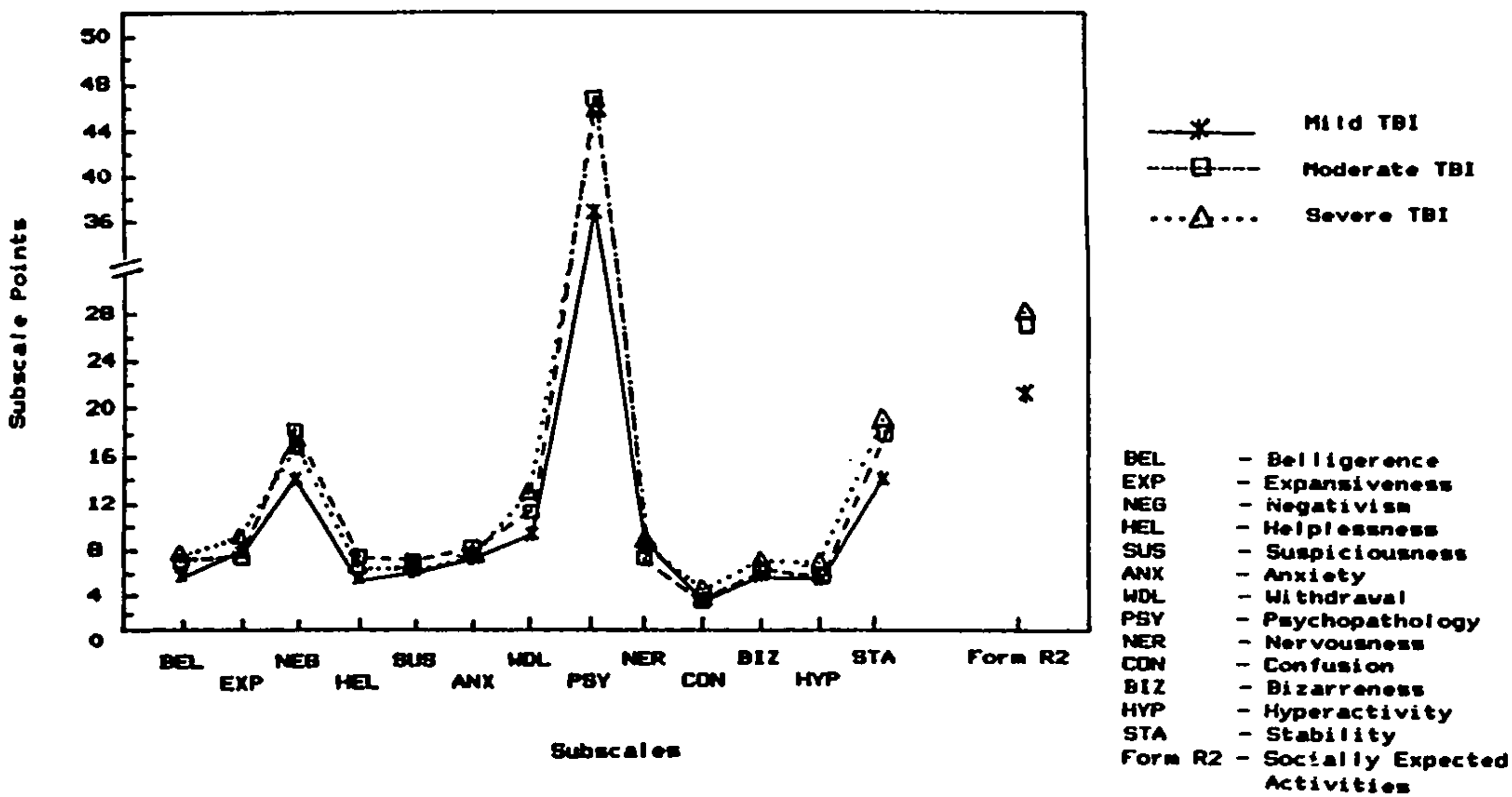

Table 3.21. MANOVA Results of the SIP Data of all three Groups.

(N = 50)

Multivariate F Test

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Wilks	.54085	1.07928	24.00	72.00	.388

Univariate F Test (2,47)

Variables	F Value	Sig. of F	Tukey's HSD
Sleep/Rest	.18579	.831	
Emotional Behaviour	.39238	.678	
Body Care & Movement	1.52467	.228	
Home Management	1.01758	.369	
Mobility	1.04745	.359	
Social Interaction	.43616	.649	
Ambulation	2.44001	.098	
Alertness Behaviour	.90630	.411	
Communication	2.01992	.144	
Work	4.95324	.011	Sev.> Mild
Recreation & Pastimes	2.16432	.126	
Eating	1.30560	.281	

Table 3.22. Results of the MANOVA Procedure carried out on the Katz Adjustment Scale Form R1 Data and of the ANOVA performed on Form R2 Data of all three Groups. (N = 50)

Multivariate F Test

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Wilks	.49003	1.15374	26.00	70.00	.311

Univariate F Test (2,47)

Variables	F Value	Sig. of F	Tukey's HSD
Form R1			
Belligerence	0.83334	.441	
Expansiveness	0.50274	.608	
Negativism	1.43012	.250	
Helplessness	1.92803	.157	
Suspiciousness	0.18231	.834	
Anxiety	0.06470	.937	
Withdrawal	3.14851	.052	Severe > Mild
Psychopathology	2.51417	.092	
Nervousness	0.49593	.612	
Confusion	1.50308	.233	
Bizarreness	0.45791	.635	
Hyperactivity	1.86651	.166	
Stability	3.00358	.059	

One-way ANOVA

Test Name	F Value	Degrees of Freedom	p value	Tukey's HSD
Form R2				
Socially-Expected Activities	5.2436	2, 47	.009	Sev. > Mild

the results were found to be nonsignificant (F = 0.49, p < .311) even when level of education was controlled for (p = n.s.). Scrutiny of the subsequent univariate F-tests only revealed a significant group effect on the Withdrawal and Retardation cluster. A pairwise comparison, using Tukey's HSD at the 0.05 level, revealed the severe group to be significantly more withdrawn than the mild group. A one-way ANOVA performed on the KATZ Form R2 revealed a significant group effect ($F(2,47) = 5.24$, $p < .009$). Once again, the severe group was found to be significantly more impaired than the mild group when a pairwise comparison procedure was conducted.

Finally, although a one-way MANOVA performed on the Competency Rating Scales revealed no group effect ($F(2,47)$ = 0.85, $p < .110$), univariate F-tests revealed a significant group effect for the Relative's Form (Table 3.23). Once again, the significance was due primarily to the fact that severe TBI patients were rated as exhibiting more dysfunction than were mild TBI patients. When a paired samples t-test was computed across groups to determine whether relatives' account differed significantly or not from patients' report, results were significant for the severe group only ($t(29) = -3.82$, $p < .001$). These findings suggest that while the relatives of severe TBI patients

Table 3.23. Results of the MANOVA Procedure performed on the Competency Rating Scales of all three Groups.

(N = 50)

Multivariate F Test

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Wilks	.85039	1.94124	4.00	92.00	.110

Univariate F Test (2,47)

Variables	F Value	Sig. of F	Tukey's HSD
Competency Scale Patients	0.90644	.411	
Competency Scale Relatives	3.57060	.036	Severe > Mild

reported significantly greater maladjustment than did the patients themselves, the reports offered by the relatives of moderate and mild TBI patients were very similar to the ones given by the patients.

Factor Analysis

In order to identify the major underlying dimensions of the psychosocial measures, a PCA with varimax rotation was performed on all 12 subscales of the SIP, the two Competency Rating Scales and the KAS R1 and R2. While seven factors with an eigenvalue greater than 1 were generated, investigation of the screeplot suggested that six factors were sufficient to explain the data. The six resultant factors explained 74.4% of the total psychosocial data (Table 3.24) and were labelled as follows:

Factor 1. **General Psychopathology**

Significant loadings were obtained on many of the clusters from the Katz Adjustment Scale Form R1. These clusters are indicative of general psychopathology.

Factor 2. **Psychosocial Adjustment**

Subscales from the SIP which deal primarily with daily activities and interpersonal behaviour were found to load highly on this Factor. Note that three of the original four

Table 3.24. PCA Results of the Psychosocial Measures from the Overall Sample (N = 50).

Final Statistics

Factor	Eigenvalue	Percentage of Variance	Cumulative Percentage
1	11.00305	39.3	39.3
2	3.61152	12.9	52.2
3	1.92811	6.9	59.1
4	1.62054	5.8	64.9
5	1.44720	5.2	70.0
6	1.20874	4.3	74.4

Significant Loadings on Varimax Rotated Factors

	Factors					
Scales	1	2	3	4	5	6
KZNegativeness	.88935					
KZBelligerence	.87340					
KZSuspiciousness	.85928					
KZPsychopathology	.79596					
KZBizarreness	.71194					
KZHelplessness	.62805					
KZNervousness	.60721					
KZExpansiveness	.60397					
KZHyperactivity	.48464					
SIP-Sleep/Rest		.84845				
SIP-Mobility		.83698				
SIP-Home Managmt		.72135				
SIP-Social Inter.		.63260				
SIP-Emotional Beh.		.60648				
SIP-Alertness Beh.		.56038				
KATZ Form R2			.79563			
CRS - Relative			.62742			
KZStability			.60929			
SIP-Work			.58932			
CRS - Patient				.75659		
KzConfusion				.61692		
KZAnxiety				.59067		
SIP-Ambulation					.86211	
SIP-Body C&M					.67213	
KZWithdrawal					.60170	
SIP-Communication						.70724
SIP-Recreation/Pastimes						.69618

Note. Table abbreviations: KZ=Katz Adjustment Scale, SIP=Sickness Impact Profile, Managmt=Management, Inter.=Interaction, Beh.=Behaviour, CRS=Competency Rating Scale, and C&M=Care and Movement.

scales of the SIP which were used in the calculation of the Psychosocial Total (Social interaction, Emotional Behaviour and Alertness Behaviour) loaded on this factor.

Factor 3. **Socially-Expected Behaviour**

The scales which loaded on this factor reflected socially-expected activities such as working, being responsible and dependable, and carrying out daily activities such as taking care of one's finances or doing the laundry.

Factor 4. **Cognitive Functioning**

High and modest loadings were obtained on scales of confusion, anxiety and competency.

Factor 5. **Physical Adjustment**

Two of the three original scales used to compute the SIP Physical total score (Ambulation and Body Care and Movement) as well as a scale indicative of motor retardation loaded on this factor.

Factor 6. **Social Interaction**

Scales sensitive to one's ability to communicate with others and one's capacity to engage in social activities were found to load on this factor.

Prediction of Psychosocial Functioning

In order to measure the strength of the relationship between the different predictors and psychosocial adjustment, canonical correlation procedures were performed. In an attempt to assess the relative predictive value of the neuropsychological factors versus that of the AIR, separate canonical correlations were carried out for these two different ways of summarizing neuropsychological data.

Using the Neuropsychological Factors

The predictor set of variables included the neuropsychological factors, the severity factor, sex, age, education, and presence/absence of skull fracture while the criteria consisted of the six empirically-derived psychosocial factors. Table 3.25 summarizes the results of the canonical correlation. In order to avoid the pitfalls associated with simply using the level of significance to decide which canonical functions should be interpreted, the three criteria suggested by Hair, Anderson, Tatham and Grablowsky (1979) were used: i) level of significance, ii) magnitude of the canonical relationship, and iii) redundancy measure of shared variance.

The overall results indicated that the predictor set exerted a statistically significant impact on the criterion

Table 3.25. Canonical Correlation: Relationship between the Predictor Variables (Neuropsychological Factors) and the Psychosocial Data (N = 50).

Multivariate F-Test

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Wilks	.05326	1.59360	78.00	177.03	.006

Root No.	Eigenvalue	Canonical Correlation	% Variance	Wilks' Lambda	p value
1	3.63856	0.88567	0.78442	0.05326	.006
2	0.70712	0.64360	0.41422	0.24704	.691
3	0.62432	0.61997	0.38436	0.42172	.876
4	0.32417	0.49479	0.24481	0.68501	.991
5	0.06369	0.24470	0.05988	0.90708	1.00
6	0.03643	0.18748	0.03515	0.96485	.994

Loadings for the canonical variables of the predictors

	CANVAR 1
Neuropsych. 1	-.20526
Neuropsych. 2	-.44739
Neuropsych. 3	-.39386
Neuropsych. 4	.31599
Neuropsych. 5	.08021
Neuropsych. 6	-.07368
Neuropsych. 7	-.21644
Neuropsych. 8	-.18162
Severity	.58169
Sex	-.29994
Age	.31902
Education	-.24004
Skull #	.16760

Loadings of the canonical of the criterion set

	CANVAR 1
Adjustment 1	-.19563
Adjustment 2	.49984
Adjustment 3	.25635
Adjustment 4	.07963
Adjustment 5	.78527
Adjustment 6	.15226

Note. Table abbreviations: CANVAR=Canonical variate, Neuropsych.=Neuropsychology, and Skull #=Skull fracture.

variables. The procedure yielded one significant canonical correlation ($p = .006$), indicating that there was only one unique dimension of common variance between the predictors and the psychosocial domain. As indicated by the square of this canonical correlation, the present results revealed that the variance shared by the two canonical variates within the first canonical correlation was 78.4%.

In order to identify the structure of the variates (the linear combinations of variables from each data set), the structure coefficients were studied using the general rule of thumb of a value greater than .30 for meaningfulness (Pedhazur, 1982). Using this guideline, it was revealed that the second, third, and fourth neuropsychological factors (dominant manual speed, visual-spatial, and complex attention and long-term memory), the severity factor, and age were the most critical predictor dimensions associated with the canonical variate. With respect to the criterion data set, Factors 2 (psychosocial adjustment) and 5 (physical adjustment) were found to contribute most significantly to the linear combination. In other words, the significant association between the two sets of data was determined by manual speed, visual-spatial skills, complex attention and memory on one hand and psychosocial as well as physical adjustment on the other. The signs of the coefficients suggested that motor slowness, visual-spatial impairment, deficient attention and memory, increasing age as well as increasing severity of TBI were most important in predicting psychosocial and physical maladjustment.

It is also possible with this statistical procedure to determine the proportion of the total variance of each data set that can be accounted for by the canonical variates. With respect to the predictor set, the canonical variate accounted for 9.27% of the total variance of the predictor variables. As far as psychosocial outcome was concerned, the canonical variate reflected 16.67% of the total variance.

Finally, when carrying out a canonical correlation procedure, it is important to verify the meaningfulness of the results derived thus far by investigating the nature of the redundancy coefficients. These coefficients indicate which variables from one battery are associated with the variates from the other battery and determine the amount of the criterion variance that is accounted for or shared with the predictor variables. Since the present research is predictive in nature, it is only necessary to consider the redundancy coefficient for the criterion set (Pedhazur, 1982). In the current analysis, it was suggested that only 13.07% of the variance in the psychosocial variables was predictable from the canonical variate for the predictor variables. This percentage figure, which is considerably lower than the previously noted 78.4%, suggests that while a strong canonical correlation was obtained between the linear composites of the two data sets, these linear composites did not extract significant portions of variance from their respective sets of variables.

Using the AIR

The results of the canonical correlation procedure performed using the AIR instead of the neuropsychological factors as one of the predictors are summarized in Table 3.26. The results revealed one highly significant canonical correlation ($\underline{p} < .0001$), indicating one unique dimension of common variance between the predictors and the psychosocial factors. The variance shared by the two canonical variates was of the order of 69.07%.

Evaluation of the structure coefficients revealed that, in order of importance, the AIR, severity factor, sex, and age contributed most significantly to the linear combination. With respect to the criterion data set, Factors 5 (physical adjustment), 3 (socially-expected behaviour) , and 2 (psychosocial adjustment) constituted the most critical dimensions associated with the canonical

Table 3.26. Canonical Correlation: Relationship between the Predictor Variables (using AIR) and the Psychosocial Data (N = 50).

Multivariate F-Test

Test Name	Value	Approx. F	Hypoth. DF	Error DF	Sig. of F
Wilks	.17687	2.27884	36.00	169.63	.0001

Root No.	Eigenvalue	Canonical Correlation	% Variance	Wilks' Lambda	p value
1	2.23320	0.83109	0.69071	0.17687	.000
2	0.33710	0.50211	0.25211	0.57186	.536
3	0.26341	0.45661	0.20849	0.76463	.786
4	0.02027	0.14095	0.01987	0.96604	.997
5	0.01413	0.11803	0.01393	0.98563	.961
6	0.00045	0.02118	0.00045	0.99955	.890

Loadings for the canonical variables of the predictors	CANVAR 1	Loadings of the canonical of the criterion set	CANVAR 1
AIR	-.78156	Adjustment 1	.22376
Severity	-.67627	Adjustment 2	-.30043
Sex	.39067	Adjustment 3	-.38622
Age	-.30542	Adjustment 4	.10459
Education	.27123	Adjustment 5	-.81195
Skull #	-.20861	Adjustment 6	-.20078

Note. Table abbreviations: CANVAR=Canonical variate, AIR=Average Impairment Rating, and Skull #=Skull fracture.

variate. The results suggested that increasing neuropsychological impairment, severe TBI, increasing age as well as being male were most important in predicting psychosocial maladjustment.

With respect to the variance of each data set that can be attributed to the canonical variates, it became apparent that 23.85% of the total variance of the predictor variables was accounted for by the canonical variate while 16.67% of the variance of the psychosocial data set was accounted for by the canonical variate.

Finally, analysis of the redundancy coefficient for the criterion set indicated that 11.51% of the variance in the psychosocial variables was predictable from the canonical variate for the predictor variables.

Hypothesis One

The first hypothesis postulated that the neuropsychological variables would be better predictors of psychosocial adjustment than would indices of severity (coma length, PTA duration, GCS score, and skull fracture) or demographic variables such as age, sex, and education.

The structure coefficients listed in Table 3.25 suggested that the best predictor in the first canonical variate was the severity factor (made up of GCS score, coma length, and PTA duration). While three of the neuropsychological factors were found to load significantly on the first canonical variate, age similarly loaded significantly. Moreover, the results of multiple regression analyses, using the neuropsychological factors as predictors, performed on the psychosocial factors (Tables 3.27) and select psychosocial measures (Tables 3.28) revealed that the demographic and severity parameters were generally more significant than the neuropsychological measures. In fact, regardless of whether psychosocial factors or measures were used as the dependent variables, in only two instances did a neuropsychological factor prove to be more significant than any other parameters. With respect to the psychosocial factors (Table 3.27), the neuropsychological factor which proved to be significant was the Motor Strength one which is more of a physical measure than an index of pure neuropsychological functioning. Only in the case of the CRS-Relative's Form (Table 3.28) did a neuropsychological factor, the visual-spatial one, surpass the predictive value of other parameters.

In contrast to the results obtained on the basis of the neuropsychological factors, the canonical correlation performed on the AIR (Table 3.26) revealed that

Table 3.27. Significant Results of Multiple Regression Analyses Performed on the Psychosocial Factors Using Neuropsychological Factors, Age, Education, Sex, Skull Fracture, and Severity Factor as the Independent Variables.

(N = 50)

Factors	Predictor(s)	Parameter Estimate	Standard Error	T-Value	Sig. F
Psych. 1	Age	-.041419	.016247	-2.549	.01
Psych. 2	Neuro. 7	-.539037	.160993	-3.348	.002
	Sex	-.700102	.319774	-2.189	.03
Psych. 3	Education	-.209420	.062404	-3.356	.002
	Neuro. 2	-.280578	.126477	-2.218	.03
Psych. 4		No variables entered			
Psych. 5	Severity	.430550	.116306	3.702	.0001
	Age	.049399	.014486	3.410	.001
	Skull #	.640698	.239048	2.680	.01
	Sex	-.479246	.230345	-2.081	.04
Psych. 6		No variables entered			

Note. Table abbreviations: Psych.=Psychosocial, Neuro.=Neuropsychological, and Skull #=Skull Fracture.

Table 3.28. Significant Results of Multiple Regression Analyses Performed on Select Psychosocial Measures Using Neuropsychological Factors, Age, Education, Sex, Skull Fracture, and Severity Factor as the Independent Variables.

(N = 50)

Measures	Predictor(s)	Parameter Estimate	Standard Error	T-Value	Sig. F
SIP-Work	Severity	13.114364	3.722458	3.523	.001
	Education	-6.488953	1.948731	-3.330	.002
	Age	1.279029	0.468684	2.729	.009
SIP-Total		No variables entered			
SIP-Psych.		No variables entered			
SIP-Phys.	Severity	2.708304	1.099064	2.464	.02
CRS-Patient's		No variables entered			
CRS-Rel.'s	Neuro. 3	-7.694483	2.740408	-2.808	.007
Katz-Form2	Education	-1.256161	.347981	-3.610	.0007

Note. Table abbreviations: Psych.=Psychosocial, Phys.=Physical, Rel.=Relative, and Neuro.=Neuropsychological.

neuropsychological performance was the best predictor of later psychosocial adjustment though severity of injury and age remained relevant predictors. In addition, sex, with male holding a negative prognostic significance, was found to count among the significant variables. Moreover, when multiple regression analyses were performed with the use of the AIR on both psychosocial factors (Table 3.29) and select psychosocial measures (Table 3.30), AIR was the best predictor in five out of eight significant equations. It rated second best predictor in two additional equations after level of education.

The abovementioned results suggest that while analyses based on the neuropsychological factors failed to support the first hypothesis, statistical procedures employing the AIR, a summary index of neuropsychological functioning, provided strong support for the hypothesis. Consequently, the first hypothesis can be said to be partially supported by the present data.

Hypothesis Two

The prediction that psychosocial adjustment would be inversely proportional to the severity of the neuropsychological impairment constituted the second hypothesis of the present investigation.

Table 3.29. Significant Results of Multiple Regression Analyses Performed on the Psychosocial Factors Using AIR, Age, Education, Sex, Skull Fracture, and Severity Factor as the Independent Variables.

(_N_ = 50)

Factors	Predictor(s)	Parameter Estimate	Standard Error	t-Value	Sig. F
Psych. 1	Age	-.041419	.016247	-2.549	.01
Psych. 2		No variables entered			
Psych. 3	Education	-.167703	.064837	-2.587	.01
	AIR	.467888	.219348	-2.138	.04
Psych. 4		No variables entered			
Psych. 5	AIR	.881972	.189383	4.657	.0000
	Age	.047278	.014397	3.284	.002
	Skull #	.729783	.239546	3.047	.004
Psych. 6		No variables entered			

Note. Table abbreviations: Psych.=Psychosocial, AIR=Average Impairment Rating, and Skull #=Skull Fracture.

Table 3.30. Significant Results of Multiple Regression Analyses Performed on Select Psychosocial Measures Using AIR, Age, Education, Sex, Skull Fracture, and Severity Factor as the Independent Variables.

(*N* = 50)

Measures	Predictor(s)	Parameter Estimate	Standard Error	T-Value	Sig. F
SIP-Work	AIR	25.941178	6.014524	4.313	.0001
	Education	-5.456322	1.893921	-2.881	.006
	Age	1.138084	0.445292	2.556	.014
SIP-Total	AIR	6.926294	2.336992	2.964	.005
SIP-Psych.		No variables entered			
SIP-Phys.	AIR	6.612279	1.697204	3.896	.0003
CRS-Patient's		No variables entered			
CRS-Rel.'s	AIR	14.210202	4.489315	3.165	.003
Katz-Form2	Education	-1.047680	.345326	-3.034	.004
	AIR	2.695469	1.168263	2.307	.03

Note. Table abbreviations: Psych.=Psychosocial, Phys.=Physical, Rel.=Relative, and AIR=Average Impairment Rating.

Table 3.31 presents correlations among select neuropsychological variables and select psychosocial measures. Different measures of neuropsychological functioning were selected, the AIR was used, and psychosocial composites were chosen. In addition, given the high report of work-related maladjustment in this sample of TBI patients, the SIP Work subscale was also included in this table. Inspection of these results indicated that, indeed, the majority of correlation coefficients between the two domains (with the exception of correlations for Trail-Making Parts A and B, WCST-Total Perseverations, Grooved Pegboard, and AIR for which an elevated score is suggestive of impairment), were negative. Interestingly, while very significant results were obtained on the CRS-Relative's Form, SIP Work subscale, SIP Physical Total, SIP Total score and KAS-R2, measures which all have a strong physical component, significant correlations were less frequently obtained with respect to measures more related to "pure" psychosocial functioning. Scrutiny of Table 3.31 further reveals that very few significant correlations were obtained with respect to the CRS-Patient's Form, perhaps indicating the relative insensitivity of this measure for psychosocial maladjustment.

Table 3.31. Correlations Between Certain Neuropsychology Variables and Select Psychosocial Measures.

(N = 50)

	Psychosocial Measures						
Neuropsych. Variables	CompetPt	CompetSo	SIPWork	SIPPhys	SIPPsych	SIPToT	KATZR2
FSIQ	-.16	-.32**	-.40***	-.42***	-.27*	-.36***	-.37***
VIQ	-.08	-.24*	-.33**	-.30*	-.20	-.25*	-.40***
PIQ	-.20	-.34**	-.35**	-.42***	-.29*	-.37***	-.25*
Bl.Des.	-.23*	-.42***	-.33**	-.32**	-.29*	-.38***	-.10
Obj.Ass.	-.13	-.37***	-.33**	-.49***	-.39***	-.46***	-.39
WMS MQ	-.10	-.41***	-.35**	-.30*	-.17	-.26*	-.34**
CVLTTOT	.11	-.31**	-.36***	-.35**	-.15	-.26*	-.30*
FAS	-.01	-.25*	-.35**	-.10	.04	-.05	-.28*
Animals	-.05	-.29*	-.25*	-.25*	.00	-.12	-.18
Naming	.02	-.27*	-.42***	-.36***	-.20	-.36***	-.34**
TrailAT	.02	.14	.35**	.37***	.08	.23*	.10
TrailBT	.03	.19	.38***	.45***	.22	.28*	.16
WCST#C	-.16	-.28*	-.16	-.22	-.15	-.24*	-.12
WCSTTotP	.08	.27*	.02	.05	.05	.10	.12
FingPR	-.19	-.30*	-.44***	-.33**	-.13	-.26*	-.26*
HandPR	-.25*	-.27*	-.35**	-.42***	-.27*	-.35**	-.24*
PegBPR	.22	.27*	.34**	.31*	.13	.18	.18
AIR	.14	.42***	.56***	.49***	.23*	.39***	.39***

* $p<.05$. ** $p<.01$. *** $p< .005$

Note: CompetPt=Competency Rating Scale-Patient's Form, CompetSo=Competency Rating Scale-Relative's Form, SIPWork=Sickness Impact Profile Work subscale, SIPPhys=Sickness Impact Profile Physical Total, SIPPsych=Sickness Impact Profile Psychosocial Total, SIPTot=Sickness Impact Profile Total Score, KATZR2=Katz Adjustment Scale-Form R2, FSIQ=Full Scale Intelligence Quotient, VIQ=Verbal Intelligence Quotient, PIQ=Performance Intelligence Quotient, BL.Des.=Block Design, Obj.Ass.=Object Assembly, WMS MQ=Wechsler Memory Scale Memory Quotient, CVLTTOT=California Verbal Learning Test Total number of words produced, FAS=F-A-S Word Fluency Task, TrailAT=Trail-Making Test Part A Total time, TrailBT=Trail-Making Test Part B Total time, WCST#C=Wisconsin Card Sorting Task Total number of categories achieved, WCSTTotP=Wisconsin Card Sorting Task Total number of perseverative responses, FingPR=Finger-tapping task with preferred hand, HandPR=Hand grip strength with preferred hand, PegBPR=Grooved Pegboard with preferred hand, and AIR=Average Impairment Rating.

Overall, these results support the contention that as neuropsychological impairment increases, psychosocial adjustment decreases. Consequently, the second hypothesis can be said to be supported.

Hypothesis Three

On the basis of the documented pathophysiological damage following a TBI, it was postulated that, among the neuropsychological measures, indices of attention and memory would be most relevant in predicting psychosocial adjustment.

Scrutiny of the structure coefficients listed in Table 3.25 indicated that, although a factor of complex attention and delayed memory was among the variables which loaded significantly on the first canonical variate, the best neuropsychological variables were those pertaining to motor speed and visual-spatial skills. As well, the results of the multiple regression analyses (Tables 3.27 and 3.28) did not demonstrate the memory and attention factor to be significant. Finally, inspection of the correlation coefficients obtained in Table 3.31 indicated that the neuropsychological measures with the highest number of highly significant results ($p < .005$) were those pertaining to general cognitive functioning (FSIQ), visual organization

(Object Assembly), and naming abilities. Neuropsychological measures related to general cognitive functioning, visual-spatial skills, naming, and motor strength counted among the measures with the highest number of significant correlations. The present results therefore failed to support this hypothesis.

Chapter IV

DISCUSSION

Before embarking upon a discussion of the results just outlined, three factors which may limit the applicability of the current findings should be mentioned. For one, given that 82% of the sample suffered a moderate or severe head injury, the present results may not be generalizable to individuals whose TBI is less severe. Secondly, despite statistical measures taken to improve the subject-variable ratio, the limited sample size nevertheless resulted in a lower ratio than hoped for in some of the statistical analyses. The present results are therefore in need of replication with larger samples to ensure that the findings are truly representative of a sample of moderate to severe TBI patients. Finally, the impact of substituting estimated values for missing data remains uncertain.

Epidemiological Data

Age and Education

The present sample was characterized by a mean age of 27.2 years and an average education of 12.34 years. These figures describing a relatively young population are compatible with those reported in the literature (Dikmen & Reitan, 1977; Hall, Cope, & Rappaport, 1985; Karol, 1989; Munro Cullum & Bigler, 1986; Oddy, Humphrey, & Uttley, 1978; Rimel, Giordani, Barth, Boll, & Jane, 1981; Temkin, Dikmen, Machamer, & McLean, 1989). Seventy-four percent of all participants suffered a TBI as a result of a motor vehicle accident. This figure is again in agreement with most publications reporting road accidents as the main cause of head injuries (Bowers & Marshall, 1980; Bruckner & Randle, 1972; Carlsson, von Essen, & Lofgren, 1968; Heiskanen & Sipponen, 1970; Hpay, 1971; Karol, 1989; Klonoff, Snow & Costa, 1986; Rimel, 1981; Tate, Lulham, Broe, Strettles, & Pfaff, 1989). The compatibility of the present results with those previously reported attest to the representativeness of the present sample of TBI patients, keeping in mind, however, the preponderence of moderate to severe injuries and the relatively high socioeconomic class from which the participants were obtained.

Causes of TBI

More than 83% of severe TBI patients and 72% of moderate TBI cases were victims of motor vehicle accidents while only 44% of mild TBI cases were involved in such accidents. In fact, the majority of mild TBI patients suffered their injury as a result of a blow to the head or fall. This breakdown is as expected as the majority of patients involved in traffic accidents would be more likely to suffer a more severe head injury than those involved in situations where less impact velocity may be implicated. The different mechanisms implicated in head injury resulting from motor vehicle accidents or from falls have recently been recognized: while the former type results in a high percentage of diffuse injuries and comparatively few operative hematomas, the latter is associated with a relatively higher frequency of hematomas (Eisenberg & Weiner, 1987).

Sex

The one epidemiological figure reported in the present study which was discrepant with other publications consisted of the sex ratio which only marginally favored a male majority (54% of subjects were males). The only other recent report of such marginal male ratio was that of Timming, Orrison, and Mikula (1982) with a percentage value of 56.7 in favor of severe TBI males. While the low male percentage reported herein might suggest that females were more willing to participate, therefore lowering the overall male percentage figure, scrutiny of the original list of potential participants revealed a higher, though still less than expected, male percentage value. Indeed, while the 65 male percentage value characteristic of the initial pool of subjects parallels the 63% figure reported in an earlier study (Denny-Brown, 1945), it still generally fell short of most reports which clearly point to an overwhelming male majority (71%, Bowers & Marshall, 1980; 75%, Dye, Milby, & Saxon, 1979; 81%, Kerr, Kay, & Lassman, 1971; 82.1%, Klonoff, Snow, & Costa, 1986; 81% males, Munro Cullum & Bigler, 1986; 74%, Temkin, Dikmen, Machamer, & McLean, 1989). It has even been reported that the male TBI patient can outnumber injured females in a ratio of up to five to one (Field, 1976). To the researcher's knowledge, only one source to date published a female superiority in a TBI group with a 55% figure (Jellinek, Torkelson, & Harvey, 1982).

The male majority in TBI samples has commonly been explained on the basis that men may be more likely to engage in potentially dangerous work, to drink heavily, and to engage in high-speed car driving, therefore becoming more at risk for head injuries (Bond, 1984). The current lower incidence of male victims may suggest that cultural and social characteristics which were once believed to put men at higher risk may have changed, therefore reflecting social and cultural changes in sex-specific activities. The alternative explanation of a population skewed in favor of a female majority did not hold when census figures for three major Canadian cities (Montreal, Toronto, and Vancouver) were compared with that of the Ottawa-Hull region as all figures ranged between 50% and 51.3% for the mean age range of the present sample. Since sex has not been found to be significantly related to TBI patients' ability to resume former work in previous studies (Carlsson, von Essen, & Lofgren, 1968; Denny-Brown, 1945), it was felt that this variable would not unduly influence the results.

Skull Fracture

Review of data concerning the prognostic value of a skull fracture in a TBI population with respect to eventual outcome reveals contradictory results. On the one hand, some researchers have documented its favorable prognostic value. For instance, Timming, Orrison, and Mikula (1982) reported that severe TBI patients with a skull fracture had a significantly better outcome than those without. The notion that a skull fracture may lead to better outcome can presumably be explained on the grounds that at the time of trauma, the bulk of the impact on the brain is attenuated by the bony structure, therefore dissipating the initial force of impact and preventing more severe injury (Timming, Orrison, & Mikula, 1982).

In contrast to this view, other centers have reported that a skull fracture represents impressive evidence of head trauma (Klove & Cleeland, 1972). In favor of this position, it has been documented that the incidence of skull fracture is proportional to the ensuing length of posttraumatic amnesia for moderate TBI patients (Russell & Smith, 1961) and is significantly higher among TBI patients who showed unequivocal signs of residual brain damage than in those who only suffered from postconcussional symptoms (Kay, Kerr, & Lassman, 1971). As well, among a sample of moderate TBI patients, those with a skull fracture appeared to have suffered relatively more severe injury than those without as judged by their Glasgow Coma Scale score (Rimel, Giordani, Barth & Jane's, 1982). With respect to outcome per se, the presence of skull fracture has been associated with significant delay in recovery (Denny-Brown, 1945).

The present results, whereby both the severe (63.3%) and the mild (66.7%) groups did not suffer a skull fracture while the majority of moderate TBI patients did (72.5%), would appear to mitigate against either view. Indeed, when two-tailed _t_-tests were carried out to investigate the possibility that patients having suffered a skull fracture might report a differential level of psychosocial adjustment than those without, the results failed to show any significant results for the overall sample, supporting earlier claims concerning the neutral impact of the presence/absence of skull fracture with respect to level of recovery (Jennett and Teasdale, 1981), ability to return to work (Gilchrist & Wilkinson, 1979), and adaptive and cognitive abilities (Klove & Cleeland, 1972).

Though some of the analyses carried out with respect to severity of injury suggested that patients with skull fractures were characterized by greater psychosocial maladjustment than their counterparts without skull fractures, the large number of t-tests performed may well have led to spurious findings. Significant results were only obtained on two of the SIP subscales: On the Work subscale, the moderate TBI patients with a skull fracture reported significantly greater maladjustment than did the moderate TBI patients without ($t(7) = -3.01$, $p = 0.02$), while the mild TBI patients with a skull fracture reported significantly greater difficulties in the domain of Body Care and Movement than did the mild TBI patients without a skull fracture ($t(7) = -3.60$, $p = .02$). However, given the large number of t-tests performed, only differences significant at $p < 0.01$ should be accepted, therefore rendering all current analyses nonsignificant. Perhaps more convincing of the small predictive value of a skull fracture is the fact that, out of all the multiple regression analyses performed (Tables 3.27 to 3.30), skull fracture qualified as a significant predictor with respect only to Psychosocial Factor 5.

Legal Involvement

The possible interaction between legal involvement and psychosocial outcome was not systematically analyzed in this study. However, in light of the absence of significant differences between the three groups of severity of TBI and past or present legal involvement, it would appear that being involved in litigation did not have a significant effect on the psychosocial adjustment level attained. This would corroborate previous reports suggesting that symptoms reported following a TBI are not significantly related to nor secondary to litigation involvement (McKinlay, Brooks, Bond, Martinage, & Marshall, 1981; Rimel, Giordani, Barth, Boll, & Jane, 1981). A recent review on the effects of compensation and litigation on symptomatology posttrauma indeed suggested that there was no empirical evidence to support the claim that posttraumatic symptoms were caused by the claims process, though such involvement may result in additional stressors for the patient (Binder, 1986).

Neuropsychological Data

The neuropsychological profile of the overall sample generally fell within normal limits, with the exception of measures related to verbal memory, complex attention, naming, and fine manipulative skills. While this profile of cognitive functioning is the same as that reported by Tabaddor, Mattis, and Zazula (1984) in a group of severe and moderate TBI patients, it describes a level of neuropsychological functioning that is remarkably high for patients having suffered a significant TBI. Two possible explanations may account for the relatively intact cognitive functioning of this sample.

For one, the selection criterion which required all participants to have undergone a comprehensive neuropsychological exam between 6 months and 1 year posttrauma may have served to eliminate TBI patients who were too impaired to be tested relatively shortly following injury, therefore favorably biasing the sample of patients. Alternatively, the relatively intact functioning of these participants may reflect the fact that the present sample was drawn from a population whose level of premorbid functioning was elevated. However. the premorbid level of intelligence of the overall sample (IQ = 110.79) calculated on the basis of education, fell at the low end of the High Average range. This value does not support the view of a significantly gifted population. It would therefore appear that the first explanation is more plausible.

As indicated earlier, there were exceptions to the generally average performance of this sample. Indeed, deficits were noted in the areas of verbal memory, complex attention, naming, and fine manipulative skills.
The memory deficit represents the most commonly reported disturbance following head injury (Bond, 1984; Levin, Benton, & Grossman, 1982; Oddy, Coughlan, Tyerman, & Jenkins, 1985; Van Zomeren, 1981) while attentional deficits are frequently described as a sequelae of TBI (Conkey, 1938; Dikmen, Reitan, & Temkin, 1983; Van Zomeren, Brouwer, & Deelman, 1984). The impairment in fine manipulative skills may represent a specific motor impairment which results from a severe TBI. Though often not reported, this particular deficit was also observed by Tabaddor, Mattis, and Zazula (1984) in a group of TBI patients having suffered significant trauma to the brain.

As expected, the severe TBI patients fared worse than the other two groups on many of the neuropsychological tests. Indeed, they obtained lower scores on tasks of general cognition, learning and memory, language (word list generation and naming), visual-spatial skills, and attention (both simple and complex). They also performed more poorly on tests sensitive to executive function. When the level of performance between groups on the whole battery of tests was evaluated statistically, the significant univariate $\underline{F}$ values suggested that the neuropsychological functions most susceptible to the effects of severe TBI were verbal abilities (intelligence and language), verbal memory and learning, visual-spatial skills, complex attention, mental flexibility, and motor speed, with the severe TBI group performing consistently worse than either or both groups on these measures. These findings are generally commensurate with those reported previously (Dye, Saxon, & Milby, 1981; Prigatano & Fordyce, 1986), and support the position that performance on cognitive measures correlates significantly with severity of injury (Bond, 1983; Brooks & Aughton, 1979; Long & Couvier, 1982).

The overall diminished performance level observed with severe TBI became most apparent when specific underlying constructs were evaluated in contrast to a wide spectrum of brain functions (whole test battery). Indeed, while a one-way MANOVA performed on the entire neuropsychological test battery was nonsignificant, a similar analysis carried out on the neuropsychological factors was found to be highly significant (p= .002). The overall nonsignificance of the analysis performed on the battery of tests was not surprising given the immutable character of some cognitive abilities following a TBI (for instance, simple verbal skills such as vocabulary tend to show little impairment after injury; Jennett & Teasdale, 1981).

Two unexpected findings emerged from the neuropsychological data of the current study. The first one consisted of the fact that, despite a generally linear relationship between neuropsychological performance and severity of injury, the moderate group performed better than did the mild group on a few occasions. With respect to motor strength, the superior performance of the moderate group may possibly be explained by sex differences, given the fact that the moderate group was predominantly male (64%) while the mild group was represented by a female majority (78%). Since males perform better than females on pure tasks of motor strength, it may well be that the moderate patients, despite the possibility that they may have suffered impairment in this area, would still score higher than the mild group which is predominantly female. This rationale, however, cannot explain the superior performance of the moderate group on tasks of general intellectual abilities as well as verbal and visual-spatial skills. While it may be tempting to postulate that the premorbid level of functioning of the moderate group may have been higher than that of the mild group, comparison of the predicted IQs calculated on the basis of education (Table 3.10) revealed a slight, though nonsignificant, superiority in the opposite direction: i.e., the mild group's premorbid IQ was approximately 2 points higher.

The second unexpected finding consisted of the relative inferiority of the preferred hand on Grooved Pegboard for both the moderate and severe groups and on a task of manual strength for the severe group only (Table 3.9). These findings suggest that the moderate and severe groups may have suffered focal left-hemispheric damage. This may further be corroborated by the findings of the MANOVA performed on the neuropsychological factors which revealed significant results with respect to verbal abilities and preferred motor speed, both dependent upon left-hemispheric processing.

<u>Psychosocial Functioning</u>

The present test results clearly documented the presence of significant psychosocial difficulties in this sample, supporting earlier claims that impairment in this area is most significant following a TBI (Hpay, 1971; Oddy, Coughlan, Tyerman, & Jenkins, 1985; Weddell, Oddy, & Jenkins, 1980).

The linear trend seen on some of the neuropsychological measures, i.e. the more severe the injury, the greater the impairent, was evident even more consistently with respect to psychosocial functioning as measured by the SIP and the Competency Rating Scales. Indeed, on 9 of the 12 SIP subscales (Sleep, Body Care and Movement, Home Management, Mobility, Ambulation, Alertness Behaviour, Communication, Work, and Recreation and Pastimes), the SIP Physical scale, SIP Psychosocial scale, SIP Total scale, both Competency Rating Scales, and KAS-R2, the more severe the injury, the greater the level of psychosocial maladjustment. Other sources have also reported a direct relation between extent of social dysfunction and severity of head injury (Godfrey, Marsh, & Partridge, 1987; Keshavan, Channabasavanna, & Narayana Reddy, 1981) though it has come to be generally accepted that, regardless of severity, TBI patients are generally dissatisfied with their life situations and have to make considerable life adjustment (Holosko & Huege, 1989).

In contrast to the linear trend observed on the SIP and Competency Rating Scales, the relationship between severity of initial trauma and reported adjustment was not obtained on more than 4 of the 13 KAS-R1 subscales (Belligerence, Withdrawal, Bizzareness, and Stability). These results may suggest that, contrary to psychosocial adjustment, psychopathology is not influenced primarily by the severity of TBI. An alternative explanation may also be that level of adjustment, as perceived and reported by a significant other, may be subject to a host of extraneous variables other than severity of trauma alone.

Subjective Complaints

Spontaneous complaints voiced by the patients during the initial interview revealed the presence of common areas of concern among the participants. Loss of friendships was reported as the most common complaint, having been voiced by 62% of all participants. This finding corroborates the contention of other research teams that the majority of patients report lack of friendships and social isolation as their greatest burden (Holosko & Huege, 1989; Karpman, Wolfe, & Vargo, 1986; Oddy, Coughlan, Tyerman, & Jenkins, 1985; Thomsen, 1984).

Another 60% of the present sample identified memory problems as the second major area of difficulties. This figure is exactly the same as that reported by Klonoff and her team (Klonoff, Snow, & Costa, 1986) and similar to most published figures to date which repeatedly show that memory problems constitute the most commonly reported complaint among TBI patients (Bond, 1979; Crawford, 1983; Hpay, 1971; Jane & Rimel, 1982; Karol, 1989; Oddy, Coughlan, Tyerman, & Jenkins, 1985; Rimel, Giordani, Barth, Boll & Jane, 1981; Thomsen, 1984; Van der Zwan, 1969; Van Zomeren & Van Den Burg, 1985).

Ranking third, a combination of decreased stamina, lack of physical endurance, and/or increased fatigue was reported by 30% of all TBI patients. A highly similar figure had previously been reported by Keshavan, Channabasavanna, and Narayana Reddy (1981) and Thomsen (1984). This complaint is particularly important since TBI patients, who may be able to carry out certain preinjury activities including work, may have very little energy left to do anything else once such activity has been carried out. Finally, 22% of all participants indicated having suffered such personality changes as increased irritability, mood changes, and lack of patience. Previous reports had estimated such problems to be present in 18% to 38% of TBI cases (Hpay, 1971;

Keshavan, Channabasavanna & Narayana Reddy, 1981; Oddy, Coughlan, Tyerman, & Jenkins, 1985; Thomsen, 1984).

As evidenced by the above figures, the nature of the spontaneous complaints most commonly voiced by the present sample was indeed very similar to that reported in the literature by various research groups, dating as far back as the 1930s (Conkey, 1938). These subjective complaints were also most similar to those reported by relatives of severe TBI patients (McKinlay, Brooks, Bond, Martinage, & Marshall, 1981).

Sickness Impact Profile

The SIP profiles revealed that the areas most compromised consisted of those related to emotional and social adjustment, alertness behaviour, communication, leisure activities, and work rather than those having to do with physical activities. The most severe difficulties, as depicted in Figure 3.1, were reported in the areas of work and alertness behaviour. The latter scale primarily reflects difficulties in cognitive function, such as impaired attention, memory, and problem solving. Overall, these findings parallel those formerly published on the long-term effects of a TBI (Bond, 1975; Crawford, 1983; Holosko & Huege, 1989; Karol, 1989; Klonoff, Snow & Costa, 1986; Macartney-Filgate, 1985; Oddy, 1984; Oddy, Coughlan, Tyerman, & Jenkins, 1985; Oddy, Humphrey, & Uttley, 1978; Prigatano, 1986). This pattern of results was obtained regardless of the severity of TBI.

As depicted in Table 3.18, the severe TBI patients rated themselves as more maladjusted on all subscales of the SIP, with the exception of the subscale dealing with emotional behaviour. The latter subscale deals with feeling useless, experiencing mood swings, acting nervous, restless, or irritable, and being hopeless about the future. Two possible explanations may account for the response of the severe TBI group. On the one hand, because these concepts presumably require intact insight and judgement, it is possible that the severe TBI patient lacks the skills necessary to make an accurate appraisal of his/her performance in such a subjective domain. This explanation is related to the concept of anosognosia by which a patient shows no awareness of his/her disability. On the other hand, it may also be that the severe TBI patient truly fails to experience such maladjustment because his/her lack of insight prevents a critical assessment of self-loss that could in turn lead to such emotional maladjustment. In contrast, the moderate and especially mild TBI patients, whose insight is presumably more preserved, may be more prone to such maladjustment secondary to their ability to appraise realistically their loss following injury. In summary, the former explanation postulates actual maladjustment but lack of insight in accurately reporting it, while the latter hypothesizes the absence of maladjustment because of a failure to accurately appraise one's situation following injury due to impaired insight.

Even though the severe TBI patients reported greater levels of maladjustment on all but one subscale of the SIP, the one-way MANOVA performed on this instrument failed to reveal a significant overall group effect. In fact, the only significant univariate F value was obtained with respect to the Work subscale on which the severe TBI patients reported significantly more difficulties than did the mild TBI patients. These results suggest that psychosocial maladjustment is more specific than general in its ramifications and would, at the same time, add support to the contention that work is the area of functioning most affected following a trauma to the brain.

Comparison of the present results with those previously published by Klonoff, Snow, and Costa (1986) reveals consistently higher levels of maladjustment in the present sample on all subscales and summary indices. This may well reflect differences in the severity of cases investigated as only 39.7% of Klonoff's sample suffered a moderate or severe TBI while 82% of the present sample suffered such injury. Notwithstanding the difference in severity of TBI, however, the pattern of results was very similar in both groups.

Katz Adjustment Scale-Relative's Form R1 and Form R2

With respect to indications of daily maladjustment and psychopathology in our overall sample of TBI, a comparison of the present KAS-R results with those obtained from a normal population (Hogarty, Katz, & Chase, 1971) revealed that patients having suffered a head injury were reported as experiencing significantly greater maladjustment in daily living and more psychopathology than normals. Even though TBI patients appeared to resemble a psychiatric population in many respects, they were also reported as being more belligerent and verbally expansive (i.e., being brash, outspoken and verbally aggressive) though less helpless, anxious, or nervous. Oddy, Humphrey, and Uttley (1978) had also reported that 'confusion' and 'verbal expansiveness' appeared to predominate in a sample of TBI patients.

The results of the KAS-R with respect to the three severity groups similarly revealed a general trend toward greater psychopathology with increasing severity of TBI: The severe group was rated as more maladjusted on all subscales, with the exception of the Negativism, Helplessness, Suspiciousness, Anxiety, and General Psychopathology subscales. On these scales, the moderate group was reported as showing more signs of psychopathology than the other two groups. Similar to the SIP results, a one-way MANOVA performed on the KAS-R1 did not reveal a statistically significant overall group effect. The only significant univariate $\underline{F}$ value was obtained on the Withdrawal subscale, with the severe TBI patients being described as more withdrawn than the mild TBI patients. A significant difference was also obtained on the KAS-R2, with the severe group receiving a poorer evaluation of their performance of socially expected activities than did the mildly injured patients.

Comparison of the performance of the present sample on the KAS-R1 and R2 with that of Klonoff, Snow, and Costa's (1986) sample again reveals some discrepancies. The present sample performed poorer on all subscales. While multiple $\underline{t}$-tests performed between the data of the present sample and the normative data of Hogarty, Katz, and Chase (1971) revealed highly significant differences on all scales used, a similar analysis undertaken by Klonoff's team had only revealed significant differences on 7 of the 13 subscales of KAS-R1. As well, while Klonoff's team reported better performance on the part of their TBI group on almost all subscales in comparison to Hogarty, Katz, and Chase's psychiatric norms, the present results suggest a comparable degree of dysfunction between a sample of TBI patients and a psychiatric population. With respect to performance of socially expected activities, the present findings indicate that TBI patients engage less often in such activities than a normal population but moreso than a psychiatric population. Klonoff's team reported that TBI patients performed the same as normals and failed to carry out a comparison of the performance of their TBI sample with that of a psychiatric population. As stated above, the differences between Klonoff's results and those of the present investigation most likely stem from the fact that the present sample contained more cases of severe TBI.

Competency Rating Scales

A comparison of the views presented by each one of the severity groups again highlights the fact that the severe TBI patients rated themselves as less maladjusted than did the moderate group. The tendency of the more severely injured patients to complain less about changes in their daily performance has been reported elsewhere (Wild, Posthuma, & Bowman, 1985). This again may reflect the anosognosia documented in cases of severe injury.

Finally, a comparison of the level of adjustment reported by a significant other and that obtained from the patient per se for the overall sample revealed a significantly higher level of maladjustment reported by a third party. These results are compatible with those previously published by Prigatano and Fordyce (1986) which indicated that the majority of TBI patients, as compared with the ratings of family members, rated themselves as generally more competent. While a higher level of complaints was also reported by the significant others in all three severity groups, this difference was only found to be significant with respect to the severe group. As expected, the severe group was rated as more maladjusted than the other two groups by their relatives on the Competency Rating Scale. This suggests that, for the moderate and mild TBI patients, testimonies from the two sources tended to be fairly similar, despite the still slightly higher report of maladjustment items by the significant others.

The significantly higher endorsement of items by the significant others of severe TBI patients may reflect one of two realities. On one hand, the perception of the relatives of severe TBI patients may have been heightened by their own psychological reaction to the TBI. Indeed, there have been reports indicating that a significantly higher proportion of relatives of severe TBI individuals as compared with relatives of individuals with minor TBI have psychiatric disturbance that are anxiety-based (Livingston, Brooks, & Bond, 1985b). On the other hand, this may simply reflect the contention of Prigatano and Fordyce (1986) that, the greater the tendency for patients to minimize their disability relative to a third party, the greater the patient's level of neuropsychological impairment. In the present sample, the severe group was certainly found to be neuropsychologically impaired.

While a specific analysis of the reasons underlying the discrepancy of the testimonies obtained from two different sources was not undertaken, it is important to keep in mind that each source of information may contain its own biases. For instance, while the patient's report may be compromised by diminished or impaired insight (McKinlay & Brooks, 1984; Thomsen, 1984), the relative's testimony may also be distorted by that person's emotional reaction to the familial disruption caused by the TBI and the associated high levels of stress (McKinlay & Brooks, 1984). Alternatively, relatives' reports can be biased by a denial of disability which serves as a coping strategy (Romano, 1974; Roueche & Fordyce, 1983) or by the fact that they may only report areas that are problematic to themselves (Livingston, Brooks, & Bond, 1985a). Finally, the views of family members may be largely influenced by their relationship with and feelings for the patient (Heaton & Pendleton, 1981).

The reality of perceptual differences offered by different sources in judging psychosocial functioning has been acknowledged by many (Fahy, Irving & Millac, 1967; Jennett, 1984; Walker, 1972). The types of discrepancies noted have suggested that a divergence of opinion may be more likely to occur when personality changes are implicated (Oddy, Coughlan, Tyerman & Jenkins, 1985). In the end, it may be more worthwhile to accept the discrepancies between patients' self-reports and relatives' testimonies as a representative view of the patient's social environment than to attempt to determine whose view is more accurate.

Prediction of Psychosocial Adjustment

The canonical correlation procedures identified several important predictors of psychosocial adjustment and highlighted the significant relationship between long-term adjustment in a TBI population and factors such as neuropsychological functioning, severity of initial trauma, and other epidemiological variables.

Before proceeding to a detailed discussion and implication of these results, it is important to emphasize the fact that a closer scrutiny at the meaningfulness of the results by way of the redundancy coefficients revealed that only 13.07% (in the case of the neuropsychological factors) to 11.51% (with respect to the AIR) of the variance in the psychosocial domain was predictable from the canonical variate of the predictor set of variables. These values indicate the amount of the psychosocial variance that was accounted for by the predictor variables. These figures, in comparison to the 78.4% (neuropsychological factors) and 69.07% (AIR) figures obtained with respect to the shared variance, suggest that, while strong canonical correlations were obtained between the linear composites of the two data sets, these linear composites did not extract significant portions of variance from their respective sets of variables. As such, the following extrapolations must be considered tentative.

Analysis of the structure coefficients of the equation based on the neuropsychological factors suggested that the most critical predictor variables associated with the first canonical variate consisted of neuropsychological data (dominant manual speed, visual-spatial skills [pure and memory], complex attention and long-term memory), severity of initial trauma, and age. The two most significant factors, in order of importance, were those of severity of trauma and dominant manual speed. With respect to the criterion data set, the factors which contributed most to the linear combination consisted of adjustment related to both psychosocial and physical adjustment. The psychosocial adjustment dimension referred to interpersonal relationships, emotional behaviour, alertness behaviour, and daily activities such as home management. The physical dimension consisted of ambulation, body movement, and withdrawal (psychomotor retardation). In summary, the present results suggested that psychosocial and physical maladjustment following TBI was best predicted by and related to increasing severity of trauma, motor slowness, visual-spatial impairment, deficient long-term memory, impaired attention, and increasing age.

Marked differences emerged when the results of the equation based on the AIR were analyzed. The structure coefficients then revealed neuropsychological functioning to be the most significant predictor, surpassing the predictive usefulness of the severity factor. This equation indicated that psychosocial adjustment some 2 1/2 years postinjury was best predicted by neuropsychological impairment, severity of initial trauma, sex (male being associated with greater maladjustment), and age. The coefficient associated with AIR surpassed that obtained by any of the other variables in either equation, attesting to the superior power of such an index. In addition, results of separate multiple regression analyses highlighted the superior predictive value of AIR versus that of neuropsychological factors.

As will be recalled, the results based on the AIR had led to full support of the first hypothesis although results based on the neuropsychological factors had failed to support it. The significant value of the AIR is most likely related to the fact that an overall index of performance is a more sensitive representation of one's level of neuropsychological functioning. The representation of one's cognitive functioning in terms of factors leads to a reduction of the overall power of neuropsychological data due to the division of the whole into its components. The present results certainly add validity to the use of an AIR when attempting to summarize neuropsychological functioning for predictive purposes.

The high loading obtained in both equations with respect to physical adjustment in contrast to the more modest value associated with psychosocial adjustment suggests that, in a sample of TBI patients, physical well-being is more easily predicted than is adjustment related to interpersonal relationships and emotional behaviour. As well, the most significant correlations in Table 3.31 were obtained especially with respect to scales related to work and physical well-being than with "purer" psychosocial aspects such as interpersonal relations and emotional behaviour. This may reflect the fact that, given the complex nature of the latter category of functioning, it is unlikely that significant correlations with any one measure would be obtained. Given the complex nature of the items making up the psychosocial factor, in contrast to the straightforward nature of the physical factor, it is not surprising to obtain such results: A simple dimension of functioning would be more amenable to measurement and prediction.

Significant Predictors

Neuropsychological Data

The results of the analyses performed on the basis of the AIR strongly support the view that neuropsychological impairment plays an important role in predicting the long-term psychosocial adjustment of TBI patients. Earlier reports had documented the predictive usefulness of an AIR with respect to employment (Heaton, Chelune, & Lehman, 1978; Newman, Heaton, & Lehman, 1978). Moreover, the superior predictive usefulness of neuropsychological data is in agreement with the commonly reported belief that mental handicaps play a greater role than physical disability in determining eventual recovery (Bond, 1975, 1976; Bruckner & Randle, 1972; Jennett et al., 1981; Heiden et al., 1979; Hpay, 1971; Lewin, Marshall, & Roberts, 1979; Najenson et al., 1980). Performance on tests of learning and memory has been specifically correlated with different aspects of patients' ability to function in everyday life, including the ability to return to work (Prigatano et al., 1984).

The results of the canonical correlations (Tables 3.25 and 3.26) and simple multiple correlations (Table 3.31) demonstrated that performance on cognitive tasks was generally negatively correlated with psychosocial functioning, suggesting that increasing neuropsychological impairment was related to decreasing level of adjustment. With respect to the simple correlations, the pattern of results was found especially with respect to scales related to functioning in daily activities, work, and physical well-being than with "purer" psychosocial aspects such as social interactions and emotional functioning. This is similar to the contention of McSweeny et al. (1985) that neuropsychological status in chronically ill patients is more consistently related to activities of daily living and basic social role performance than to emotional status. Once again, this may reflect the fact that, given the complex nature of the latter category of functioning, it is unlikely that significant correlations with any one measure would be obtained. In any event, these results led to support of the second hypothesis which postulated that psychosocial adjustment would be inversely proportional to the severity of neuropsychological functioning.

The usefulness of motor functioning (Factor 2) was highlighted in Table 3.25, with motor slowness being associated with later psychosocial maladjustment. Support concerning the important contributory role of motor disability with respect to long-term outcome has been documented in the literature. Indeed, previous results have commented on the predictive power of degree of motor impairment (with respect to strength and/or speed) in relation to several indices of everyday function (Dresser et al., 1973; Klonoff, Costa, & Snow, 1986; McSweeney et al., 1985; Timming, Orrison, & Mikula, 1982). Moreover, the relationship between neurological motor deficits and motor response patterns and rehabilitation (Najenson et al., 1974), long-term outcome (Jennett et al., 1979), or subsequent performance on neuropsychological testing (Dye, Milby, & Saxon, 1979) has been demonstrated. Additional support has been derived from studies showing that patients who are dependent in mobility exhibit more distress than those who are independent (Jellinek, Torkelson, & Harvey, 1982). Finally, Oddy and his team (Oddy, Humphrey, & Uttley, 1978) indicated that physical disability was a more important factor than subjective complaints in determining social recovery 6 months posttrauma.

As evidenced by the failure to find support for the third hypothesis, indices of attention and memory were not found to be most relevant in predicting psychosocial adjustment. As indicated in Table 3.25, although a factor of complex attention and delayed memory (Factor 4) counted among the variables which loaded significantly on the first canonical variate, the best neuropsychological predictors were those pertaining to motor speed and visual-spatial skills. As well, inspection of the multiple regression analyses (Tables 3.27 and 3.28) indicated that manual strength, visual-spatial skills, and motor speed were important predictors. Finally, results of Table 3.31 revealed that the neuropsychological measures most significantly correlated with the psychosocial measures were those related to general cognitive functioning, visual organization, visual-spatial skills, naming, and motor strength.

The failure of measures of attention and memory to be most significant with respect to predicting psychosocial adjustment may reflect the fact that the measures used in this study were not sensitive enough for the types of deficits usually detected following TBI. As suggested by the results of Stuss, Stethem, Hugenholtz, and Richard (1989), complex tasks of attention, such as the Brown-Peterson Auditory Short Term Memory Task and the Paced Auditory Serial Addition, should be used in order to detect the selective deficit in complex attention that follows TBI. Unfortunately, because these two tests were only systematically used in one of the two settings from which the participants were obtained, it was not possible to use these variables in the statistical analyses. Finally, as suggested by the results of McSweeny et al. (1985), more complex, multi-functional neuropsychological tasks may have to be used if prediction of overall life functioning is to be increased.

Univariate versus Multivariate Statistics? Though the predictive usefulness of neuropsychological data was clearly demonstrated by analyses based on the AIR, the results of the canonical correlation based on the neuropsychological factors revealed the validity of the different factors to be less than expected on the basis of previous reports. A possible explanation for the modest correlations obtained here may refer to the type of statistical analyses carried out by different research teams. Most earlier claims of a highly significant relationship between neuropsychological functioning and later psychosocial adjustment were based on correlation matrices between a host of variables. Interestingly, the present results are very similar to those reported by Klonoff and her team (Klonoff, Costa, & Snow, 1986) who also made use of multivariate statistics. Their results had suggested that quality of life was adversely affected by increasing severity of head injury and greater residual motor deficits.

The predictive usefulness of neuropsychological factors is usually found to be more modest when multivariate analyses are conducted than when more simple analyses are performed. Indeed, investigators who have advocated a strong relationship between neuropsychological data and psychosocial functioning have tended to study the usefulness of single indicators or predictors individually with a disregard for the interrelationships between the various variables used (Keshavan, Channabasavanna, & Narayana Reddy, 1981; Newman, Heaton, & Lehman, 1978). Most recently, it was again reported that specific self-care abilities and employment status were strongly related to measures of attention, motor speed, verbal ability, and executive functions in a sample of severe TBI patients (Cicerone & DeLuca, 1990); These conclusions were based on the results of simple correlations between a host of factors.

It is believed that, in the assessment of the complex relationship between psychosocial outcome and cognitive functioning, multiple correlations do not constitute the most appropriate statistical procedure and may lead to conclusions which do not take into consideration the interaction of a multitude of variables. Baird et al. (1987), in fact, recently advocated the use of multivariate approaches in predicting global life quality.

Severity of Injury

The present results highlighted the predictive value of the severity factor (based on the initial GCS score, coma length, and PTA duration). A review of the literature concerning predictors of long-term adjustment following TBI clearly documents the predictive usefulness of measures of severity of injury (Rimel, Giordanni, Barth, & Jane, 1982).

Indeed, despite the infrequent report concerning the nonsignificant correlation between initial Glasgow Coma Scale (GCS) score and outcome at 1 year posttrauma in moderate-severe TBI patients (Tabaddor, Mattis, & Zazula, 1984), the majority of investigators have documented the accuracy with which GCS scores can predict long-term outcome (Heiden et al., 1979; Young et al., 1981).

Similarly, support for the robust correlation between posttraumatic amnesia (PTA), another commonly used index of severity, and long-term outcome is plentiful. Increased duration of PTA in different severity groups of TBI patients has been reported to be associated with increased severity of psychosocial sequelae (Bond, 1975, 1976; Hpay, 1971), social dysfunction (Keshavan, Channabasavanna, & Narayana Reddy, 1981), delay in returning to work (Van Zomeren & Van den Burg, 1985), degree of disability (Jennett et al., 1976), and general outcome (Jennett & Teasdale, 1981; Lewin, Marshall & Roberts, 1979; Stuss & Richard, 1982). It is still important to observe that, despite the overwhelming evidence concerning the usefulness of PTA as a predictor, some investigators have commented on the inconsistent validity of PTA as a predictor of disability (Wrightson & Gronwall, 1981).

The relation between coma length and long-term functioning is even more widely acclaimed. Indeed, it has long been documented that depth of coma is one of the most reliable severity predictors of outcome following a TBI (Jennett et al., 1979). More specifically, it is known that the longer the coma, the poorer the adjustment will be with respect to the patient's long-term functioning (Fowler, 1981; Timming, Orrison & Mikula, 1982), psychosocial skills (Keshavan, Channabasavanna, & Narayana Reddy, 1981; Tate et al., 1989), rehabilitation (Gilchrist & Wilkinson, 1979; Najenson et al., 1974), and employment (Adey, 1967; Carlsson, von Essen, & Lofgren, 1968; Denny-Brown, 1945; Dresser et al., 1973; Heiskanen & Sipponen, 1970).

Age

The present findings support the predictive usefulness of age with respect to long-term psychosocial adjustment. Evidence concerning the predictive value of age with respect to outcome has also been documented extensively (Jennett et al., 1979; Russell & Smith, 1961) and has pointed to better long-term outcome in younger patients (Eisenberg & Weiner, 1987; Teuber, 1975; Timming, Orrison, & Mikula, 1982). The negative prognostic significance of increasing age at the time of injury has been documented with respect to rehabilitation potential (Najenson et al., 1974), long-term outcome (Heiden et al., 1979; Lewin, Marshall & Roberts, 1979; Lewin & Roberts, 1979), level of recovery (Hpay, 1971; Jennett & Teasdale, 1981), ability to return to work (Bruckner & Randle, 1972; Carlsson, von Essen, & Lofgren, 1968; Heiskanen & Sipponen, 1970), and psychosocial adjustment (Bond, 1976; Fowler, 1981). Notwithstanding the general consensus concerning the effect of age at the time of injury on later psychosocial adjustment, there have been reports concerning the insignificant contribution of age with respect to long-term outcome (Gilchrist & Wilkinson, 1979; Keshavan, Channabasavanna, & Narayana Reddy, 1981; Tabaddor, Mattis, & Zazula, 1984; Young et al., 1981) in random samples of TBI patients.

Several possible explanations for the generally upheld age effect have been presented over the years, with the most popular views having to do with the "poorer tolerance to mechanical forces of aging cells and cell systems of the brain, or to a reduced functional reserve-capacity of the nervous system with increasing age" (Carlsson, von Essen, & Lofgren, 1968. P. 247) and "decrease in plasticity and tendency to be less able to compensate for deficits" (Fowler, 1981, p. 127).

Sex

The canonical correlation based on the AIR revealed sex to be a significant predictor, even moreso than age. The results indicated that males were characterized by more maladjustment than were females. As well, results of multiple regression analyses performed on the basis of neuropsychological factors and psychosocial factors (Table 3.27) found sex to be a significant predictor, though never the best one, with respect to psychosocial (Factor 2) and physical (Factor 5) adjustment. This significant impact of sex was unexpected, given the fact that previous reports had found sex not to be significantly related to the TBI patients' ability to resume former work (Carlsson, von Essen, & Lofgren, 1968; Denny-Brown, 1945). A review of these studies, however, suggests that their results may reflect the fact that their samples were restricted with respect to sex, given the usual male majority reported in most TBI studies. In other words, given the fact that restricted samples (decreased variance) may lead to Type II error (by which the null hypothesis is accepted when an alternative hypothesis is true), the results of these two investigators may have reflected such error.

The fact that the current sample was equally represented by both men and women would therefore allow for a more accurate assessment of the relationship between sex and psychosocial adjustment following a TBI. The most parsimonious explanation for the adverse effect of the male sex on later psychosocial adjustment could simply be that men in this sample suffered more severe TBI than did women. While it is true that 92.6% of men suffered a moderate-severe TBI while only 69.6% of women suffered a similar injury, a Chi Square analysis of the relationship between sex and severity of injury (Table 3.6) failed to support this view.

An alternative explanation relates to differential level of accomplishment between sexes. Men may have been employed in higher level jobs prior to their accident, and given the more complex nature of their work, may have had more difficulty returning to work. Women, on the other hand, may have little difficulty returning to lower level jobs which are far less demanding.

In order to assess the soundness of the latter view, a rank ordering of psychosocial maladjustment on the SIP Work subscale was done by sex. Given the likelihood that higher level positions would be associated with higher education, level of education was considered in this rank ordering. As outlined in Table 4.1, little support was obtained for the position that men with the most difficulties tended to

Table 4.1. Rank Ordering of Psychosocial Maladjustment as Indexed by the SIP Work Subscale With Respect to Sex and Education.

(N=50)

Sex	Education	SIP Work Percentage
13 Men	M: 10.85	70.1
9 Women	M: 12.00	
1 Man	11	50.1
1 Man	10	42.5
1 Woman	12	39.4
1 Woman	12	28.7
1 Man	14	
1 Man	18	26.2
1 Man	12	20.2
1 Woman	10	19.0
2 Women	M: 12.0	15.5
1 Man	14	
1 Man	16	7.2
8 Men	M: 11.9	0.0
8 Women	M: 13.6	

have a higher level of education than women. Also in contradiction to this position were general results regarding the mean education level by sex. Indeed, as illustrated in Table 4.2, women had generally attained a higher level of education at the time of injury then had men, though none of the sex differences were significant.

If anything, the values outlined in Table 4.2 argue in favor of women having held higher level jobs at the time of injury as they had generally attained a higher level of education at the time of injury than had the men. Indeed, a breakdown of occupational positions into three major categories for each sex (manual/unskilled, skilled/office work, and skilled/managearial) revealed that women generally occupied higher level jobs at the time of injury than did men. Excluding the 12 individuals who were students at the time of injury (5 men and 7 women) and the one man who had been unemployed since he left school, it became apparent that more women occupied higher level jobs than did men: 16 men were manual/unskilled workers; 9 women and 3 men were involved in skilled/office work; and 6 women as well as 3 men were involved in skilled/managearial positions.

Given these results, the association of lower level of maladjustment with the female sex may reflect the recently acknowledged fact that, the higher an individual's

Table 4.2. Mean Education Level of Each Sex for the Overall Sample as well as for Each Severity Group.

($\underline{N}$=50)

GROUP	Education $\underline{M}$	Education $\underline{SD}$
Overall		
Women ($\underline{n}$=23)	12.48	1.86
Men ($\underline{n}$=27)	11.82	2.15
Severe		
Women ($\underline{n}$=12)	11.75	1.77
Men ($\underline{n}$=18)	11.50	1.58
Moderate		
Women ($\underline{n}$=4)	13.50	2.08
Men ($\underline{n}$=7)	11.86	3.08
Mild		
Women ($\underline{n}$=7)	13.14	1.57
Men ($\underline{n}$=2)	14.50	2.12

occupational level before injury, the more likely it is that he/she will return to some full-time occupation due to a tolerant employer's ability to "find a sheltered niche" (Brooks, 1987, p. 66). This view was also supported by a recent study which suggested that the better educated TBI patient may be distinguishable from his/her less educated unskilled counterpart by a more supportive work environment and greater intellectual resources to deal with the aftermath of injury (Paniak, 1990). As well, given the fact that the presence of a continuing physical defect is important in the return to work of manual workers in particular (Brooks, 1987), the preponderence of male manual workers and importance of a motor factor in the present study may also account for the lower level of adjustment reported by the men.

Additional Factors

A critical review of the present research will most likely raise certain issues since some variables were not systematically investigated. It is therefore important, before concluding, to discuss two such variables: premorbid personality,characteristics and control groups.

Premorbid Personality Characteristics

It is a generally held principle that damage to the brain from various etiologies is likely to interact with premorbid features in producing a pattern of deficits. Although cases with evidence of frank psychopathology requiring hospitalization were excluded from the present study, an assessment of subtle premorbid personality disturbances was not performed.

More specifically with respect to TBI patients, it has been reported that the number of symptoms reported postinjury correlates highly with pretraumautic neuroticism (Keshavan, Channabasavanna, & Narayana Reddy, 1981) and that the postconcussional syndrome is similarly associated with premorbid constitutional differences or personality problems (Binder, 1986). However, while the role of preexisting personality features on postinjury adjustment has been documented, it has been found particularly important in cases of mild injury (Prigatano, 1986, 1987). There is very little doubt that the present study investigated the psychosocial functioning of severe TBI patients.

Other researchers have failed to demonstrate a consistent relationship between premorbid personality characteristics and posttrauma changes (Jennett & Teasdale, 1981). For instance, Kozol (1945) reported that there was little, if any, correlation between pretraumatic personality and liability to develop posttraumatic mental symptoms and that generally, posttraumatic symptoms could not be ascribed to the pretraumatic personality. As well, Hpay (1971) was of the opinion that previous personality did not appear to have much effect on posttraumatic mental sequelae. Denny-Brown (1945) reported a "surprising absence" of effect of pretraumatic characteristics on social adjustment.

In the end, despite conflicting reports concerning the impact of premorbid personality characteristics on long-term adjustment following head trauma, the assessment of such features in future research endeavors should be encouraged. It is important, however, to realize the difficulties that exist in obtaining such information. Indeed, retrospective data on the social functioning of TBI patients may be overly positive, especially when relatives are used as the source of such information (Brooks & McKinlay, 1983). It is, therefore, difficult to accept at face value the report of a relative concerning a patient's premorbid functioning.

Control Group

The present study did not make use of a control group. While the primary investigator is aware that comparison of TBI patients with an appropriate control group often leads to less impressive evidence of impaired social adjustment specific to TBI (Dikmen, McLean, & Temkin, 1986; Godfrey, Marsh, & Partridge, 1987; Oddy, Humphrey & Uttley, 1978), it nevertheless remains true that in a TBI sample, the difficulties outlined in the present study are common. In other words, though it may not be possible to attribute the results to a TBI per se, it is nevertheless warranted to describe these findings as "commonly found" in a TBI population. The difficulties in ascribing postinjury findings to the TBI per se in the absence of a control group is especially important in cases of mild injuries and may be less relevant in a sample of severe TBI. Rosenbaum and Najenson (1976), who examined the social adjustment of severe TBI army personnel and made use of an appropriate control group, reported unequivocal evidence of impairment in the TBI group.

Directions for Future Research

In light of the evidence concerning the presence of significant psychosocial difficulties in TBI patients, it is important that research in this area continues to ensure that appropriate long-term care is provided to these patients. Continuing research becomes even more important following recent reports concerning the fact that many problems identified 2 years posttrauma may increase in frequency subsequently (Thomsen, 1984), and that patients may continue to experience symptoms and difficulties even after such a substantial period of time as 7 years (Karol, 1989; Oddy, Coughlan, Tyerman, & Jenkins, 1985). These results suggest that many of the difficulties observed relatively early on, as in this study, are likely to remain permament handicaps. Finally, the majority of individuals suffering from a TBI are just entering into the prime of their productive years, therefore highlighting the need for a thourough understanding of the impact of head trauma from a social point of view.

The present results, especially those based on the neuropsychological factors, essentially replicated the findings of Klonoff and her colleagues (Klonoff, Costa, & Snow, 1986). One of the major methodological differences between the present study and that conducted by Klonoff et al., aside from the milder nature of their injuries, consisted of the fact that they used neuropsychological data as indicators (i.e., measured at the same time as the quality of life) rather than predictors. Nevertheless, essentially the same results were obtained in the two studies regardless of whether neuropsychological performance was assessed 6 months to 1 year (present study) or 2 to 4 years (Klonoff's study) posttrauma. It would therefore appear judicious to use early data to predict long-term outcome since information concerning eventual level of recovery may be most needed by the TBI patient and his/her family early on.

Previous reports have indicated that different parameters become important in the prediction of psychosocial adjustment, depending on the severity of the TBI. For instance, it has been reported that, while in moderate TBI cases the principal predictors of outcome are measures of severity of injury, this is not observed in cases of mild injury where age and education are more relevant predictors (Rimel, Giordanni, Barth, & Jane, 1982). It might, therefore, be enlightening to compute separate canonical correlation analyses for each severity group, i.e., the mild, moderate, and severe TBI patients. To date, most studies which have employed multivariate statistical analyses to explore relationships between neuropsychological data and psychosocial outcome, have utilized a heterogeneous group of TBI patients, perhaps reducing the applicability of their results. Unfortunately, in light of the limited number of subjects per severity group in the present investigation, it was not possible to undertake such analysis. Such study will have to await future research efforts.

Appendix A

SUMMARY TABLE OF THE ADVERSE PREDICTORS OF THE PSYCHOSOCIAL ADJUSTMENT OF TBI PATIENTS

Table 1: Adverse Predictors of the Psychosocial Adjustment of TBI Patients. Studies appear in chronological order. (TBI= traumatic brain injury; L=left; R=right; H=hemisphere; see text for other abbreviations.)

Researchers	Outcome Variables	Adverse Predictors
Denny-Brown (1945)	Employment status (18-month follow-up)	Age over 40 Lengthy coma Disorientation > 7 days Skull fracture Mental symptoms, especially anxiety
Raines, Peterson, Liss, & Caveness (1957)	Social and economic adjustment (2-6 years later)	Age over 19 9th grade unattained
Akerlund (1959)	Return to work (1-6 years later)	Advanced age Coma > 1 month Mental deterioration Lack of initiative Intellectual incapacity
Walker & Jablon (1961)	Adjustment in work, social & home areas (15-year follow-up)	Severity of wounding Personality changes (?)
Lishman (1966)	Psychiatric disability (intellectual, emotional & behavioral areas)	PTA > 24 hours Severity of damage R-sided sensory-motor defects R-sided visual field defects
Adey (1967)	Return to employment (5-15-year follow-up)	Unconsciousn. > 1 month
Fahy, Irving, & Millac (1967)	Personality changes & psychiatric sequelae	Prolonged PTA
Carlsson, von Essen, & Lofgren (1968)	Return to work (1 to 10 years later)	Advanced age Prolonged coma
Lishman (1968)	Affective disorders & behavioral symptoms	R-hemispheric damage Frontal-lobe damage

Table 1: continued

Researchers	Outcome Variables	Adverse Predictors
Weinstein & Lyerly (1968)	Work, Social and Sexual adjustment (2-13 years post-injury)	Severity of damage Advanced age
Muller (1969)	Social and economic (up to 12 years later)	Advanced age Pending litigation
Heiskanen & Sipponen (1970)	Working capacity (3-5 years later)	Advanced age Coma > 4 weeks
Steadman & Graham (1970)	Occupational status	PTA exceeding 24 hours Advanced age
Hpay (1971)	Psychosocial outcome (2-5 years later)	PTA > 24 hours Age over 20 Personality change
Kay & Kerr (1971)	Postconcussional syndrome (1 year later)	Married status Social class IV Industrial accident Past psychiatric illness
Bruckner & Randle (1972)	Return to work	Psychological factors (memory impairment, loss of concentration, impaired intellect) Age over 40 Post-traumatic epilepsy Hemiplegia Dysphasia Sensory loss
Dresser, Meirowsky, Weiss, McNeel, Simon & Caveness (1973)	Gainful employment (15 years post-injury)	IQ pre-injury Deep lesion Lenghty coma Hemorrhagic complication Infectious complications Aphasia Bilateral visual deficit Motor impairment Fits beyond 30 days

Table 1: continued

Researchers	Outcome Variables	Adverse Predictors
Lewinsohn & Graf (1973)	Occupational adjustment	Advanced age Cardiovascular disease Poor locomotion Lack of emotional support Poor memory Short attention span Suspiciousness Slowness Motor incoordination
Najenson, Mendelson, Schechter, David, Mintz, & Groswasser (1974)	Return to work (1-8 years later)	Prolonged unconscious. Age over 45 Severe neurological motor deficits Epilepsy Aphasia Hemianopsia
Najenson, Groswasser, Stern, Schechter, Daviv, Berghaus, & Mendelson (1975)	Social and vocational rehabilitation (6 months later)	Intellectual deficits
Pazzaglia, Frank, & Gaist (1975)	Social reintegration (2 & more years later)	Age over 20 Coma-producing caudal lesions Surgical lesions
Bond (1975, 1976)	Psychosocial outcome (3-24 months later)	PTA > 4 weeks Mental disability (memory + personality) Intelligence
Roberts (1976)	Occupational disability (10-25 years later)	Prolonged PTA Advanced age Little early improvement Personality deficits Intellectual deficits

Table 1: continued

Researchers	Outcome Variables	Adverse Predictors
Becker, Miller, Ward, Greenberg, Young, & Sakalas (1977)	Social disability (GOS)	Mass lesions Midline brain shift Impaired/absent oculo-cephalic responses
Dikmen & Reitan (1977)	Emotional sequalae (18-month follow-up)	Neurophychological deficits on admission Age
Groswasser, Mendelson, Stern, Schechter, & Najenson (1977)	Vocational capacity (30 months later)	Behavioral disturbances + Disability unawareness
Levin, & Grossman (1978)	Psychopathology	Hemiparesis Severe injury Aphasia EEG abnormalities CAT abnormalities Agitation in acute phase
Oddy, Humphrey, & Uttley (1978)	Social recovery (6 months later)	Physical disability PTA > 7 days Number of subjective complaints
Gilchrist & Wilkinson (1979)	Return to work	Lenghty coma Mental changes Number of neurological defects Unstable family background Cerebral hypoxia (?)
Heiden, Small, Caton, Weiss, & Kurze (1979)	Social outcome (GOS) (1-year follow-up)	Aging GCS < 3 Impaired eye movements Impaired motor responses Mental sequelae

Table 1: continued

Researchers	Outcome Variables	Adverse Predictors
Jennett, Teasdale, Braakman, Minderhoud Heiden, & Kurze (1979)	Social outcome (GOS) (6 months post-injury)	Deep coma Impaired pupil reaction Impaired eye movements Impaired motor responses Advanced age
Levin, Grossman, Rose, & Teasdale (1979)	Social recovery (GOS) (3-year period)	Oculovestibular deficit Advanced age Intelligence (PIQ & VIQ) Impaired memory storage Impaired memory retrieval Lengthy coma
Lewin, Marshall, & Roberts (1979)	Mental & physical outcome (10 years later)	Advanced age Impaired neurological function Prolonged PTA
Lewin & Roberts (1979)	Mental disabilities	PTA > 2 months Advanced age Coma > 1 month
Teasdale, Parker, Murray, Knill-Jones, & Jennett (1979)	Social outcome (GOS) (1 week post-injury)	Advanced age Low GCS Motor abnormality Abnormal pupillary responses Impaired eye movements Apnoea Deterioration trend
Teasdale, Skene, Parker, & Jennett (1979)	Social recovery (GOS) (6 months postinjury)	Advanced age
Bowers & Marshall (1980)	Social outcome (GOS) (6 months or more)	Multiple injuries involving the abdomen or chest

Table 1: continued

Researchers	Outcome Variables	Adverse Predictors
Najenson, Groswasser Mendelson, & Hackett (1980)	Return to work (6 months or more)	Lengthy coma Aphasia Cognitive impairment Low premorbid education level
Oddy & Humphrey (1980)	Social adjustment (2 years post-injury)	PTA > 7 days Premorbid nervousness Physical handicap
Weddell, Oddy, & Jenkins (1980)	Social adjustment (2 years postinjury)	Personality changes Impaired neurophysical status Memory loss Low Matrice score IQ < 70
Dye, Saxon, & Milby (1981)	Restitution of work and school	Lengthy coma Neuropsych data ?
Jennett, Snoek, Bond & Brooks (1981)	Social disability (GOS)	Mental handicap Severe hemiparesis Severe dysphasia Moderate and severe personality changes PTA > 4 weeks
Rimel, Giordani, Barth, Boll, & Jane (1981)	Return to work (3 months later)	Younger Lower education Lower level of employment Lower income Lower SES Greater premorbid life stress
Young, Rapp, Norton, Haack, Tibbs, & Bean (1981)	Social functioning (GOS) (1 year post-injury)	Low GCS Midline shift > 4.1 mm, if GCS = 5,6 or 7
Black & Black (1982)	Personality functioning	Posterior lesions

Table 1: continued

Researchers	Outcome Variables	Adverse Predictors
Levati, Farina, Vecchi, Rossanda, & Marrubini (1982)	Social functioning (GOS)	Absence of brainstem reflexes Poor neurological status Abnormal motor patterns Arterial hypotension Mass lesions Deep coma
Rappaport, Hall Hopkins, Belleza, & Cope (1982)	Community readjustment (1 year later)	Low admission disability rating
Rimel, Giordani, Barth, & Jane (1982)	Social functioning (GOS) (3 months later)	Subdural hematoma Severe injury Lengthy coma CT diagnosis Low GCS on discharge Prolonged PTA
Crawford (1983).	Social outcome (GOS) (3-year period)	Social handicaps Intellectual handicaps
Klonoff (1984/1986) Klonoff, Costa, & Snow (1986)	Quality of life (2-4 years post-injury)	Frontal lobe damage Cognitive deficits in areas of motor functions, memory & constructional abilities Low GCS Education Seizures Injury-test interval
McLean, Dikmen, Temkin, Wyler, & Gale (1984)	Psychosocial functioning (1 month later)	Severe damage
Tabaddor, Mattis, & Zazula (1984)	Social reintegration (GOS) (1 year later)	Dementia at discharge

Table 1: continued

Researchers	Outcome Variables	Adverse Predictors
Thomsen (1984)	Psychosocial outcome (10-15 years later)	Severe brainstem involvement Anterior lesions
Grafman, Salazar, Smutok, Vance & Brown (1985)	Community adjustment	RH: Low education Retained fragments LH: Low education Low premorbid IQ Retained fragments Both groups: Low education Low Chapman scale scores RT on Continuous Perform test Depression score
Van Zomeren & Van den Burg (1985)	Return to work (2 years later)	Prolonged PTA Forgetfulness Slowness Poor concentration Attention difficulties
Wild, Posthuma, & Bowman (1985)	Everyday life functioning (at least 7 months later)	Low scores on: Keytests (Impairment Index, Category test, TPT location, Trail B) Tapping, dominant hand Full IQ TPT total time MMPI Mf, Si & D Severe trauma

Appendix B

PSYCHOSOCIAL MEASURES

LONG-TERM PSYCHOSOCIAL ADJUSTMENT FOLLOWING A HEAD INJURY

PLEASE READ THE ENTIRE INSTRUCTIONS BEFORE YOU READ THE QUESTIONNAIRE. IT IS VERY IMPORTANT THAT EVERYONE TAKING THE QUESTIONNAIRE FOLLOWS THE SAME INSTRUCTIONS.

Introduction

Great effort is currently being put forward to improve our understanding of the long-term effects of a head injury. Information on the type of impact that a head injury has on an individual's life would help us better understand the mechanisms of such trauma and consequently, would ameliorate our management. In order to obtain such information, we need you to fill out the following questionnaire.

Instructions

You have certain activities that you do in carrying on your life. Sometimes you do all of these activities. Other times, because of your state of health, you don't do these activities in the usual way: you may cut some out; you may do some for shorter lengths of time; you may do some in different ways. These changes in your activities might be recent or longstanding. We are interested in learning about any changes that describe you today and are related to your state of health.

The questionnaire lists statements that people have told us describe them when they are not completely well. Whether or not you consider yourself sick, there may be some statements that will stand out because they describe you today and are related to your state of health. As you read the questionnaire, think of yourself today. When you read a statement that you are sure describes you and is related to your health, place a check on the line to the right of the statement. For example:

I am not driving my car __X__ (026-031)

If you have not been driving for some time because of your health, and are still not driving today, you should respond to this statement.

On the other hand, if you never drive or are not driving today because your car is being repaired, the statement, "I am not driving" is not related to your health and you should not check it. If you simply are driving less, or are driving shorter distances, and feel that the statement only partially describes you, <u>do not</u> check it. In all these cases you would leave the line to the right of the statement blank. For example:

I am not driving my car _____ (026-031)

Remember that we want you to check this statement only if you are <u>sure</u> it describes you today and is related to your state of health.

Read the introduction to each group of statements and then consider the statements in the order listed. While some of the statements may not apply to you, we ask that you please read <u>all</u> of them. Check those that describe you as you go along. Some of the statements will differ only in a few words, so please read each one carefully. While you may go back and change a response, your first answer is usually the best. Please do not read ahead.

<u>Once you have started the questionnaire, it is very important that you complete it within one day (24 hours).</u>

If you find it hard to keep your mind on the statements, take a short break and then continue. When you have read all the statements on a page, put a check in the BOX in the lower right-hand corner. If you have any questions, please refer back to these instructions.

<u>Please do not discuss the statements with anyone, including family members, while doing the questionnaire.</u>

Now turn to the questionnaire and read the statements. Remember we are interested in the recent or longstanding changes in your activities that are related to your head injury.

(SR-0499)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

---

1. I spend much of the day lying down in order to rest _____ (070-083)

2. I sit during much of the day _____ (062-049)

3. I am sleeping or dozing most of the time - day and night _____ (063-104)

4. I lie down more often during the day in order to rest _____ (066-058)

5. I sit around half-asleep _____ (065-084)

6. I sleep less at night, for example, wake up too early, don't fall asleep for a long time, awaken frequently _____ (069-061)

7. I sleep or nap more during the day _____ (071-060)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(EB-0705)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

1. I say how bad or useless I am, for example, that I am a burden on others ____ (274-087)

2. I laugh or cry suddenly ____ (272-068)

3. I often moan and groan in pain or discomfort ____ (269-069)

4. I have attempted suicide ____ (281-132)

5. I act nervous or restless ____ (284-046)

6. I keep rubbing or holding areas of my body that hurt or are uncomfortable ____ (262-062)

7. I act irritable and impatient with myself, for example, talk badly about myself, swear at myself, blame myself for things that happen ____ (273-078)

8. I talk about the future in a hopeless way ____ (283-089)

9. I get sudden frights ____ (278-074)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(BCM-2003)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

1.	I make difficult moves with help, for example, getting into or out of cars, bathtubs	_____	(168-084)
2.	I do not move into or out of bed or chair by myself but am moved by a person or mechanical aid	_____	(170-121)
3.	I stand only for short periods of time	_____	(155-072)
4.	I do not maintain balance	_____	(146-098)
5.	I move my hands or fingers with some limitation or difficulty	_____	(152-064)
6.	I stand up only with someone's help	_____	(165-100)
7.	I kneel, stoop, or bend down only by holding on to something	_____	(171-064)
8.	I am in a restricted position all the time	_____	(158-125)
9.	I am very clumsy in body movements	_____	(148-058)
10.	I get in and out of bed or chairs by grasping something for support or using a cane or walker	_____	(169-082)
11.	I stay lying down most of the time	_____	(162-113)
12.	I change position frequently	_____	(147-030)
13.	I hold on to something to move myself around in bed	_____	(143-086)
14.	I do not bathe myself completely, for example, require assistance with bathing	_____	(310-089)
15.	I do not bathe myself at all, but am bathed by someone else	_____	(312-115)
16.	I use bedpan with assistance	_____	(292-114)
17.	I have trouble getting shoes, socks, or stockings on	_____	(305-057)
18.	I do not have control of my bladder	_____	(290-124)

(CONTINUED FROM PAGE 7)

19. I do not fasten my clothing, for example, require assistance with buttons, zippers, shoelaces _____ (298-074)

20. I spend most of the time partly undressed or in pajamas _____ (302-074)

21. I do not have control of my bowels _____ (295-128)

22. I dress myself, but do so very slowly _____ (300-043)

23. I get dressed only with someone's help _____ (297-088)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(HM-0668)

THIS GROUP OF STATEMENTS HAS TO DO WITH ANY WORK YOU USUALLY DO IN CARING FOR YOUR HOME OR YARD. CONSIDERING JUST THOSE THINGS THAT YOU DO, PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH

---

1. I do work around the house only for short periods of time or rest often ____ (117-054)
2. I am doing less of the regular daily work around the house than I would usually do ____ (119-044)
3. I am not doing any of the regular daily work around the house that I would usually do ____ (120-086)
4. I am not doing any of the maintenance or repair work that I would usually do in my home or yard ____ (001-062)
5. I am not doing any of the shopping that I would usually do ____ (106-071)
6. I am not doing any of the house cleaning that I would usually do ____ (116-077)
7. I have difficulty doing handwork, for example, turning faucets, using kitchen gadgets, sewing, carpentry ____ (107-069)
8. I am not doing any of the clothes washing that I would usually do ____ (111-077)
9. I am not doing heavy work around the house ____ (115-044)
10. I have given up taking care of personal or household business affairs, for example, paying bills, banking, working on budget ____ (105-084)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(M-0719)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

1. I am getting around only within one building ____ (134-086)

2. I stay within one room ____ (128-106)

3. I am staying in bed more ____ (130-081)

4. I am staying in bed most of the time ____ (131-109)

5. I am not now using public transportation ____ (140-041)

6. I stay home most of the time ____ (133-066)

7. I am only going to places with restrooms nearby ____ (125-056)

8. I am not going into town ____ (124-048)

9. I stay away from home only for brief periods of time ____ (139-054)

10. I do not get around in the dark or in unlit places without someone's help ____ (121-072)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(SI-1450)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

---

1. I am going out less to visit people ____ (028-044)
2. I am not going out to visit people at all ____ (029-101)
3. I show less interest in other people's problems, for example, don't listen when they tell me about their problems, don't offer to help ____ (003-067)
4. I often act irritable toward those around me, for example, snap at people, give sharp answers, criticize easily ____ (015-084)
5. I show less affection ____ (007-052)
6. I am doing fewer social activities with groups of people ____ (012-036)
7. I am cutting down the length of visits with friends ____ (027-043)
8. I am avoiding social visits from others ____ (034-080)
9. My sexual activity is decreased ____ (039-051)
10. I often express concern over what might be happening to my health ____ (018-052)
11. I talk less with those around me ____ (002-056)
12. I make many demands, for example, insist that people do things for me, tell them how to do things ____ (038-088)
13. I stay alone much of the time ____ (023-086)
14. I act disagreeable to family members, for example, I act spiteful, I am stubborn ____ (249-088)
15. I have frequent outbursts of anger at family members, for example, strike at them, scream, throw things at them ____ (240-119)
16. I isolate myself as much as I can from the rest of the family ____ (237-102)

(CONTINUED FROM PAGE 11)

17. I am paying less attention to the children ____ (238-064)

18. I refuse contact with family members, for example, turn away from them ____ (256-115)

19. I am not doing the things I usually do to take care of my children or family ____ (242-079)

20. I am not joking with family members as I usually do ____ (255-043)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(A-0842)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

---

1. I walk shorter distances or stop to rest often	_____	(050-048)
2. I do not walk up or down hills	_____	(046-056)
3. I use stairs only with mechanical support, for example, handrail, cane, crutches	_____	(042-067)
4. I walk up or down stairs only with assistance from someone else	_____	(044-076)
5. I get around in a wheelchair	_____	(057-096)
6. I do not walk at all	_____	(052-105)
7. I walk by myself but with some difficulty, for example, limp, wobble, stumble, have stiff leg	_____	(049-055)
8. I walk only with help from someone	_____	(053-088)
9. I go up and down stairs more slowly, for example, one step at a time, stop often	_____	(040-054)
10. I do not use stairs at all	_____	(041-083)
11. I get around only by using a walker, crutches, cane, walls, or furniture	_____	(047-079)
12. I walk more slowly	_____	(051-035)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(AB-0777)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

1. I am confused and start several actions at a time _____ (223-090)

2. I have more minor accidents, for example, drop things, trip and fall, bump into things _____ (234-075)

3. I react slowly to things that are said or done _____ (228-059)

4. I do not finish things I start _____ (227-067)

5. I have difficulty reasoning and solving problems, for example, making plans, making decisions, learning new things _____ (224-084)

6. I sometimes behave as if I were confused or disoriented in place or time, for example, where I am, who is around, directions, what day it is _____ (231-113)

7. I forget a lot, for example, things that happened recently, where I put things, appointments _____ (222-078)

8. I do not keep my attention on any activity for long _____ (220-067)

9. I make more mistakes than usual _____ (225-064)

10. I have difficulty doing activities involving concentration and thinking _____ (217-080)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(C-0725)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

---

1. I am having trouble writing or typing _____ (191-070)

2. I communicate mostly by gestures, for example, moving head, pointing, sign language _____ (177-102)

3. My speech is understood only by a few people who know me well _____ (179-093)

4. I often lose control of my voice when I talk, for example, my voice gets louder or softer, trembles, changes unexpectedly _____ (197-083)

5. I don't write except to sign my name _____ (188-083)

6. I carry on a conversation only when very close to the other person or looking at him _____ (178-067)

7. I have difficulty speaking, for example, get stuck, stutter, stammer, slur my words _____ (176-076)

8. I am understood with difficulty _____ (200-087)

9. I do not speak clearly when I am under stress _____ (201-064)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

THE NEXT GROUP OF STATEMENTS HAS TO DO WITH ANY WORK YOU USUALLY DO OTHER THAN MANAGING YOUR HOME. BY THIS WE MEAN ANYTHING THAT YOU REGARD AS WORK THAT YOU DO ON A REGULAR BASIS.

DO YOU USUALLY DO WORK OTHER THAN MANAGING YOUR HOME? ____ YES ____ NO

➡ IF YOU ANSWERED YES, GO ON TO THE NEXT PAGE.

➡ IF YOU ANSWERED NO:

ARE YOU RETIRED? ____ YES ____ NO

IF YOU ARE RETIRED, WAS YOUR RETIREMENT RELATED TO YOUR HEALTH? ____ YES ____ NO

IF YOU ARE NOT RETIRED, BUT ARE <u>NOT</u> WORKING, IS THIS RELATED TO YOUR HEALTH? ____ YES ____ NO

➡ NOW SKIP THE NEXT PAGE.

(W-0515)

IF YOU ARE NOT WORKING AND IT IS NOT BECAUSE OF YOUR HEALTH, PLEASE SKIP THIS PAGE.

NOW CONSIDER THE WORK YOU DO AND RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH. (IF TODAY IS A SATURDAY OR SUNDAY OR SOME OTHER DAY THAT YOU WOULD USUALLY HAVE OFF, PLEASE RESPOND AS IF TODAY WERE A WORKING DAY.)

---

1. I am not working at all _____ (100-361)

   (IF YOU CHECKED THIS STATEMENT, SKIP TO THE NEXT PAGE.)

2. I am doing part of my job at home _____ (094-037)
3. I am not accomplishing as much as usual at work _____ (096-055)
4. I often act irritable toward my work associates, for example, snap at them, give sharp answers, criticize easily _____ (088-080)
5. I am working shorter hours _____ (095-043)
6. I am doing only light work _____ (086-050)
7. I work only for short periods of time or take frequent rests _____ (090-061)
8. I am working at my usual job but with some changes, for example, using different tools or special aids, trading some tasks with other workers _____ (092-034)
9. I do not do my job as carefully and accurately as usual _____ (097-062)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(RP-0422)

THIS GROUP OF STATEMENTS HAS TO DO WITH ACTIVITIES YOU USUALLY DO IN YOUR FREE TIME. THESE ACTIVITIES ARE THINGS THAT YOU MIGHT DO FOR RELAXATION, TO PASS THE TIME, OR FOR ENTERTAINMENT. PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

---

1. I do my hobbies and recreation for shorter periods of time _____ (215-039)
2. I am going out for entertainment less often _____ (214-036)
3. I am cutting down on some of my usual inactive recreation and pastimes, for example, watching TV, playing cards, reading _____ (207-059)
4. I am not doing any of my usual inactive recreation and pastimes, for example, watching TV, playing cards, reading _____ (208-084)
5. I am doing more inactive pastimes in place of my other usual activities _____ (211-051)
6. I am doing fewer community activities _____ (216-033)
7. I am cutting down on some of my usual physical recreation or activities _____ (210-043)
8. I am not doing any of my usual physical recreation or activities _____ (209-077)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

(E-0705)

PLEASE RESPOND TO (CHECK) ONLY THOSE STATEMENTS THAT YOU ARE SURE DESCRIBE YOU TODAY AND ARE RELATED TO YOUR STATE OF HEALTH.

1. I am eating much less than usual _____ (085-037)
2. I feed myself but only by using specially prepared food or utensils _____ (073-077)
3. I am eating special or different food, for example, soft food, bland diet, low-salt, low-fat, low-sugar _____ (081-043)
4. I eat no food at all but am taking fluids _____ (077-104)
5. I just pick or nibble at my food _____ (083-059)
6. I am drinking less fluids _____ (080-035)
7. I feed myself with help from someone else _____ (074-099)
8. I do not feed myself at all, but must be fed _____ (075-117)
9. I am eating no food at all, nutrition is taken through tubes or intravenous fluids _____ (076-133)

CHECK HERE WHEN YOU HAVE READ ALL STATEMENTS ON THIS PAGE ☐

NOW, PLEASE REVIEW THE QUESTIONNAIRE TO BE CERTAIN YOU HAVE FILLED OUT ALL THE INFORMATION. LOOK OVER THE BOXES ON EACH PAGE TO MAKE SURE EACH ONE IS CHECKED SHOWING THAT YOU HAVE READ ALL OF THE STATEMENTS. IF YOU FIND A BOX WITHOUT A CHECK, THEN READ THE STATEMENTS ON THAT PAGE.

KATZ ADJUSTMENT SCALE: RELATIVE's FORM

Name (subject): ________________________

Nom (respondent): ________________________

Date: ________________

Respondent's relationship to the subject:

1. Mother	5. Brother/Sister	9. Cousin
2. Father	6. Grand-parent	10. Friend
3. Spouse	7. Aunt/uncle	11. In Laws
4. Child	8. Niece/nephew	12. Other _______________

Sex of respondent: Male _________ Female ________

How well is respondent acquainted with subject's behavior?

1. Hardly at all	4. Pretty well
2. Not so well	5. Very well
3. Fairly well	

Instructions

The forms which you will be asked to fill out are disigned to give us some idea of how ______________________ is from day to day, and how he/she gets along with other people. It will give us some idea about his/her behavior and how well he/she has been getting along with others since the head injury.

For each statement, please check the column which best describes his/her behavior in the past few weeks, including today.

Do not spend too much time on any one question but make sure that you check every question.

Thank you for your collaboration and rest assured that your answers will remain strictly confidential.

Please note: The masculine gender has been used throughout the questionnaire. It is meant to be generic and as such, represents both the feminine and masculine gender.

KAS Form R1
Relative's Form

	1 Almost never	2 Some-times	3 Often	4 Almost always
1. Has trouble sleeping	----	----	----	----
2. Gets very critical, starts to blame himself for things	----	----	----	----
3. Cries easily	----	----	----	----
4. Feels lonely	----	----	----	----
5. Acts as if he has no interests in things	----	----	----	----
6. Is restless	----	----	----	----
7. Has periods where he can't stop moving or doing something	----	----	----	----
8. Just sits	----	----	----	----
9. Acts as if he doesn't have much energy	----	----	----	----
10. Looks worn out	----	----	----	----
11. Feelings get hurt easily	----	----	----	----
12. Feels that people don't care about him	----	----	----	----
13. Does the same thing over and over again without reason	----	----	----	----
14. Passes out	----	----	----	----
15. Gets very sad, blue	----	----	----	----
16. Tries too hard	----	----	----	----
17. Needs to do things very slowly to do them right	----	----	----	----
18. Has strange fears	----	----	----	----

	1 Almost never	2 Some-times	3 Often	4 Almost always
19. Afraid something terrible is going to happen	____	____	____	____
20. Gets nervous easily	____	____	____	____
21. Jittery	____	____	____	____
22. Worries or frets	____	____	____	____
23. Gets sudden fright for no reason	____	____	____	____
24. Has bad dreams	____	____	____	____
25. Acts as if he sees people or things that aren't there	____	____	____	____
26. Does strange things without reason	____	____	____	____
27. Attempts suicide	____	____	____	____
28. Gets angry and breaks things	____	____	____	____
29. Talks to himself	____	____	____	____
30. Acts as if he has no control over his emotions	____	____	____	____
31. Laughs or cries without reason	____	____	____	____
32. Has mood changes without reason	____	____	____	____
33. Has temper tantrums	____	____	____	____
34. Gets very excited for no reason	____	____	____	____
35. Gets very happy for no reason	____	____	____	____
36. Acts as if he doesn't care about other people's feelings	____	____	____	____
37. Thinks only of himself	____	____	____	____
38. Shows his feelings	____	____	____	____
39. Generous	____	____	____	____
40. Thinks people are talking about him	____	____	____	____

	1 Almost never	2 Some-times	3 Often	4 Almost always
41. Complains of headaches, stomach trouble, other physical ailments	____	____	____	____
42. Bossy	____	____	____	____
43. Acts as if he's suspicious of people	____	____	____	____
44. Argues	____	____	____	____
45. Gets into fights with people	____	____	____	____
46. Is cooperative	____	____	____	____
47. Does the opposite of what he is asked	____	____	____	____
48. Stubborn	____	____	____	____
49. Answers when talked to	____	____	____	____
50. Curses at people	____	____	____	____
51. Deliberately upsets routine	____	____	____	____
52. Resentful	____	____	____	____
53. Envious of other people	____	____	____	____
54. Friendly	____	____	____	____
55. Gets annoyed easily	____	____	____	____
56. Critical of other people	____	____	____	____
57. Pleasant	____	____	____	____
58. Gets along well with people	____	____	____	____
59. Lies	____	____	____	____
60. Gets into trouble with the law	____	____	____	____
61. Gets drunk	____	____	____	____
62. Is dependable	____	____	____	____

	1 Almost never	2 Some-times	3 Often	4 Almost always
63. Is responsible	____	____	____	____
64. Argues (talks) back	____	____	____	____
65. Obedient	____	____	____	____
66. Shows good judgment	____	____	____	____
67. Stays away from people	____	____	____	____
68. Takes drugs other than recommended by hospital or clinic	____	____	____	____
69. Shy	____	____	____	____
70. Quiet	____	____	____	____
71. Prefers to be alone	____	____	____	____
72. Needs a lot of attention	____	____	____	____
73. Behavior is childish	____	____	____	____
74. Acts helpless	____	____	____	____
75. Is independent	____	____	____	____
76. Moves about very slowly	____	____	____	____
77. Moves about in a hurried way	____	____	____	____
78. Clumsy; keeps bumping into things or dropping things	____	____	____	____
79. Very quick to react to something you say or do	____	____	____	____
80. Very slow to react	____	____	____	____
81. Gets into peculiar positions	____	____	____	____
82. Makes peculiar movements	____	____	____	____
83. Hands tremble	____	____	____	____
84. Will stay in one position for a long period of time	____	____	____	____

	1 Almost never	2 Sometimes	3 Often	4 Almost always
85. Loses track of day, month, or year	____	____	____	____
86. Forgets his address or other places he knows well	____	____	____	____
87. Remembers the name of people	____	____	____	____
88. Acts as if he doesn't know where he is	____	____	____	____
89. Remembers important things	____	____	____	____
90. Acts as if he's confused about things; in a daze	____	____	____	____
91. Acts as if he can't get certain thoughts out of his mind	____	____	____	____
92. Acts as if he can't concentrate on one thing	____	____	____	____
93. Acts as if he can't make decisions	____	____	____	____
94. Talks without making sense	____	____	____	____
95. Hard to understand his words	____	____	____	____
96. Speaks clearly	____	____	____	____
97. Refuses to speak at all for periods of time	____	____	____	____
98. Speaks so low you cannot hear him	____	____	____	____
99. Speaks very loudly	____	____	____	____
100. Shouts or yells for no reason	____	____	____	____
101. Speaks very fast	____	____	____	____
102. Speaks very slowly	____	____	____	____
103. Acts as if he wants to speak but can't	____	____	____	____
104. Keeps repeating the same idea	____	____	____	____

	1 Almost never	2 Some-times	3 Often	4 Almost always
105. Keeps changing from one subject to another for no reason	____	____	____	____
106. Talks too much	____	____	____	____
107. Says that people are talking about him	____	____	____	____
108. Says that people are trying to make him do or think things he doesn't want to	____	____	____	____
109. Talks as if he committed the worst sins	____	____	____	____
110. Talks about how angry he is at certain people	____	____	____	____
111. Talks about people or things he's very afraid of	____	____	____	____
112. Threatens to injure certain people	____	____	____	____
113. Threatens to tell people off	____	____	____	____
114. Says he is afraid that he will injure somebody	____	____	____	____
115. Says he is afraid that he will not be able to control himself	____	____	____	____
116. Talks about strange things that are going on inside his body	____	____	____	____
117. Says how bad or useless he is	____	____	____	____
118. Brags about how good he is	____	____	____	____
119. Says the same thing over and over again	____	____	____	____
120. Complains about people and things in general	____	____	____	____
121. Talks about big plans he has for the future	____	____	____	____

	1 Almost never	2 Some-times	3 Often	4 Almost always
122. Says or acts as if people are after him	----	----	----	----
123. Says that something terrible is going to happen	----	----	----	----
124. Believes in strange things	----	----	----	----
125. Talks about suicide	----	----	----	----
126. Talks about strange sexual ideas	----	----	----	----
127. Gives advice without being asked	----	----	----	----

KAS FORM R2

	1 Is not doing	2 Is doing some	3 Is doing regularly	4 Does not apply
1. Helps with household chores	----	----	----	----
2. Visits his friends	----	----	----	----
3. Visits his relatives	----	----	----	----
4. Entertains friends at home	----	----	----	----
5. Dresses and takes care of himself	----	----	----	----
6. Helps with the family budgeting	----	----	----	----
7. Remembers to do important things on time	----	----	----	----
8. Gets along with family members	----	----	----	----
9. Goes to parties and other social activities	----	----	----	----
10. Gets along with neighbors	----	----	----	----
11. Helps with family shopping	----	----	----	----
12. Helps in the care and training of children	----	----	----	----
13. Goes to church	----	----	----	----
14. Takes up hobbies	----	----	----	----
15. Works	----	----	----	----
16. Supports the family	----	----	----	----

Patient Competency Rating (Patient's Form), Neuropsychological Rehabilitation Program, Presbyterian Hospital

Identifying Information

Patient's Name: ______________________________

Patient's Age: __________

Date: __________

Instructions

The following is a questionnaire that asks you to judge your ability to do a variety of very practical skills. Some of the questions may not apply directly to things you often do, but you are asked to complete each question as if it were something you "had to do." On each question, you should judge how easy or difficult a particular activity is for you and mark the appropriate space.

Competency Rating

	Can't do	Very difficult to do	Can do with some difficulty	Fairly easy to do	Can do with ease
1. How much of a problem do I have in preparing my own meals?	___	___	___	___	___
2. How much of a problem do I have in dressing myself?	___	___	___	___	___
3. How much of a problem do I have in taking care of my personal hygiene?	___	___	___	___	___
4. How much of a problem do I have in washing the dishes?	___	___	___	___	___
5. How much of a problem do I have in doing the laundry?	___	___	___	___	___
6. How much of a problem do I have in taking care of my finances?	___	___	___	___	___
7. How much of a problem do I have in keeping appointments on time?	___	___	___	___	___
8. How much of a problem do I have in starting conversation in a group?	___	___	___	___	___
9. How much of a problem do I have in staying involved in work activities even when bored or tired?	___	___	___	___	___
10. How much of a problem do I have in remembering what I had for dinner last night?	___	___	___	___	___
11. How much of a problem do I have in remembering names of people I see often?	___	___	___	___	___
12. How much of a problem do I have in remembering my daily schedule?	___	___	___	___	___
13. How much of a problem do I have in remembering important things I must do?	___	___	___	___	___

	Can't do	Very difficult to do	Can do with some difficulty	Fairly easy to do	Can do with ease
14. How much of a problem would I have driving a car if I had to?	___	___	___	___	___
15. How much of a problem do I have in getting help when I'm confused?	___	___	___	___	___
16. How much of a problem do I have in adjusting to unexpected changes?	___	___	___	___	___
17. How much of a problem do I have in handling arguments with people I know well?	___	___	___	___	___
18. How much of a problem do I have in accepting criticism from other people?	___	___	___	___	___
19. How much of a problem do I have in controlling crying?	___	___	___	___	___
20. How much of a problem do I have in acting appropriately when I'm around friends?	___	___	___	___	___
21. How much of a problem do I have in showing affection to people?	___	___	___	___	___
22. How much of a problem do I have in participating in group activities?	___	___	___	___	___
23. How much of a problem do I have in recognizing when something I say or do has upset someone else?	___	___	___	___	___

	Can't do	Very difficult to do	Can do with some difficulty	Fairly easy to do	Can do with ease
24. How much of a problem do I have in scheduling daily activities?	___	___	___	___	___
25. How much of a problem do I have in understanding new instructions?	___	___	___	___	___
26. How much of a problem do I have in consistently meeting my daily responsibilities?	___	___	___	___	___
27. How much of a problem do I have in controlling my temper when something upsets me?	___	___	___	___	___
28. How much of a problem do I have in keeping from being depressed?	___	___	___	___	___
29. How much of a problem do I have in keeping my emotions from affecting my ability to go about the day's activities?	___	___	___	___	___
30. How much of a problem do I have in controlling my laughter?	___	___	___	___	___

Patient Competency Rating (Relative's Form), Neuropsychological Rehabilitation Program, Presbyterian Hospital

Patient's Name: ____________________

Patient's Age: ________

Date: ________

Informant's relationship to patient (circle one):

1. Mother	8. Niece or nephew
2. Father	9. Cousin
3. Spouse	10. Friend
4. Child	11. In-law
5. Sibling	12. Ward attendant
6. Grandparent	13. Other ____________
7. Aunt or uncle	

Sex of informant:

Male ________

Female ________

How well is informant acquainted with patient's behavior?

1. Hardly at all	4. Pretty well
2. Not so well	5. Very well
3. Fairly well	

Instructions

The following is a questionnaire that asks you to judge this person's ability to do a variety of very practical skills. Some of the questions may not apply directly to things they often do, but you are asked to complete each question as if it were something they "had to do." On each question, you should judge how easy or difficult a particular activity is for them and mark the appropriate space.

Competency Rating

	Can't do	Very difficult to do	Can do with some difficulty	Fairly easy to do	Can do with ease
1. How much of a problem do they have in preparing their own meals?	___	___	___	___	___
2. How much of a problem do they have in dressing themselves?	___	___	___	___	___
3. How much of a problem do they have in taking care of their personal hygiene?	___	___	___	___	___
4. How much of a problem do they have in washing the dishes?	___	___	___	___	___
5. How much of a problem do they have in doing the laundry?	___	___	___	___	___
6. How much of a problem do they have in taking care of their finances?	___	___	___	___	___
7. How much of a problem do they have in keeping appointments on time?	___	___	___	___	___
8. How much of a problem do they have in starting conversation in a group?	___	___	___	___	___
9. How much of a problem do they have in staying involved in work activities even when bored or tired?	___	___	___	___	___

	Can't do	Very difficult to do	Can do with some difficulty	Fairly easy to do	Can do with ease
10. How much of a problem do they have in remembering what they had for dinner last night?	___	___	___	___	___
11. How much of a problem do they have in remembering names of people they see often?	___	___	___	___	___
12. How much of a problem do they have in remembering their daily schedule?	___	___	___	___	___
13. How much of a problem do they have in remembering important things they must do?	___	___	___	___	___
14. How much of a problem would they have driving a car if they had to?	___	___	___	___	___
15. How much of a problem do they have in getting help when they are confused?	___	___	___	___	___
16. How much of a problem do they have in adjusting to unexpected changes?	___	___	___	___	___
17. How much of a problem do they have in handling arguments with people they know well?	___	___	___	___	___
18. How much of a problem do they have in accepting criticism from other people?	___	___	___	___	___
19. How much of a problem do they have in controlling crying?	___	___	___	___	___

	Can't do	Very difficult to do	Can do with some difficulty	Fairly easy to do	Can do with ease
20. How much of a problem do they have in acting appropriately when they are around friends?	___	___	___	___	___
21. How much of a problem do they have in showing affection to people?	___	___	___	___	___
22. How much of a problem do they have in participating in group activities?	___	___	___	___	___
23. How much of a problem do they have in recognizing when something they say or do has upset someone else?	___	___	___	___	___
24. How much of a problem do they have in scheduling daily activities?	___	___	___	___	___
25. How much of a problem do they have in understanding new instructions?	___	___	___	___	___
26. How much of a problem do they have in consistently meeting their daily responsibilities?	___	___	___	___	___
27. How much of a problem do they have in controlling their temper when something upsets them?	___	___	___	___	___
28. How much of a problem do they have in keeping from being depressed?	___	___	___	___	___
29. How much of a problem do they have in keeping their emotions from affecting their ability to go about the day's activities?	___	___	___	___	___
30. How much of a problem do they have in controlling their laughter?	___	___	___	___	___

Appendix C

INTRODUCTORY LETTER

HÔPITAL GÉNÉRAL D'OTTAWA OTTAWA GENERAL HOSPITAL

April 11th, 1989

My name is Andree Tellier and I am currently conducting research on the effects of a head injury on long-term psychosocial adjustment, i.e. your ability to resume former activities (work, leisure activities). I am conducting this work as part of my doctoral dissertation.

In order to look at the effects of a head injury, I would be interested in asking you questions concerning your functioning at the present time. Your name was selected because you have been seen in the department of neuropsychology of the Ottawa General hospital in the past. If you agree to participate in this study, I would be meeting with you in the near future to ask you to complete two questionnaires concerning your day-to-day functioning. I have attached the first page of each questionnaire to this letter to give you a flavor for the kind of questions that you will be invited to answer. It should take approximately 1 1/2 hours to fill these out.

I would also be interested in asking very similar questions of someone who knows you well. This could be a parent, child, relative, or friend. Once again, I have included the first page of the two questionnaires that this person would be asked to answer. As you gather from the type of questions, I am merely trying to assess your ability to perform daily activities.

For your information, I have also attached a copy of the consent form that I will ask you to sign if you do decide to participate in this research. Please note that at any time, if you wish to do so, you may withdraw from this study.

If you wish to take part in the study, or if you first want more information, please mail the enclosed postcard back to me (after

...2

first making sure that the information on the card - especially your telephone number - is correct and complete). If I have not received your card within the next two weeks, I will phone you to answer any questions that you may have and, if you are agreeable, to arrange a convenient time and place for us to meet.

I sincerely hope that you will find this study of interest. The knowledge gathered from this research would certainly help us better understand the long-term effects of a head injury on everyday functioning. Your participation is therefore very valuable and would be very much appreciated.

Thank you for your time.

Sincerely yours,

Andree Tellier, M.A.

P.S.: You may reach me by leaving a message at 737-8490 (Ottawa General Hospital) or at 231-4272.

__NOTE:__ L'étude se fera dans la langue de votre choix, c'est-à-dire, en français ou en anglais. Si vous désirez obtenir la version française de cette lettre, veuillez me le laisser savoir par l'entremise de la carte en l'indiquant sous la rubrique "Comments".

APPENDIX D

RESULTS OF MANOVA AND ANOVA PROCEDURES ON ALL PSYCHOSOCIAL MEASURES

Comparison of the Performance of Patients who completed the SIP at Home Vs. those who filled it out in a Hospital Setting.

($\underline{N}$ = 50)

Multivariate F Test

Test Name	Value	Exact F	Hypoth DF	Error DF	Sig. of F
Wilks	.69793	1.33449	12.00	37.00	.241

Univariate F Tests (1,48)

Variables	F Value	Sig. of F
Sleep/Rest	1.85045	.180
Emotional Behaviour	0.57378	.452
Body Care & Movement	3.02323	.088
Home Management	0.14973	.701
Mobility	0.12998	.720
Social Interaction	0.01372	.907
Ambulation	2.77975	.102
Alertness Behaviour	0.05520	.815
Communication	5.22153	.027
Withdrawal & Retardation	0.60356	.441
Recreation & Pastimes	1.74882	.192
Eating	0.34856	.558

One-way ANOVA (1,48)

Test Name	F Value	P Level
SIP-Total Score	1.14186	.291

Comparison of the Performance of Patients who completed the Katz Adjustment Scale Forms R1 and R2 at Home Vs. those who filled it out in a Hospital Setting.

(N = 50)

Multivariate F Test

Test Name	Value	Exact F	Hypoth DF	Error DF	Sig. of F
Wilks	.84493	0.50822	13.00	36.00	.905

Univariate F Tests (1,48)

Variables	F Value	Sig. of F
Katz Form R1		
Belligerence	1.01830	.318
Expansiveness	0.28196	.598
Negativism	0.51507	.476
Helplessness	0.12753	.723
Suspiciousness	0.15065	.700
Anxiety	0.00528	.942
Withdrawal & Retardation	3.78976	.057
Psychopathology	0.50889	.479
Nervousness	0.02630	.872
Confusion	0.28176	.598
Bizarreness	0.07583	.784
Hyperactivity	0.27566	.602
Stability	3.25051	.078

One-way ANOVA (1,48)

Test Name	F Value	P Level
Katz Form R2		
Socially-Expected Activites	2.08083	.156

Comparison of the Competency Rating Scales of Patients who completed the Questionnaires at Home Vs. those who filled them out in a Hospital Setting.

($\underline{N}$ = 50)

<u>Multivariate F Test</u>

Test Name	Value	Exact F	Hypoth DF	Error DF	Sig. of F
Wilks	.93600	1.60681	2.00	47.00	.211

<u>Univariate F Tests (1,48)</u>

Variables	F Value	Sig. of F
Competency Rating Scale Relatives' Form	2.74438	.104
Competency Rating Scale Patients' Form	0.24168	.625

APPENDIX E

PATIENTS' CONSENT FORMS

HÔPITAL GÉNÉRAL D'OTTAWA
OTTAWA GENERAL HOSPITAL

CONSENTEMENT À DES RECHERCHES MÉDICALES
CONSENT FOR MEDICAL RESEARCH

Nom de l'étude-Name of research project

____

Chercheur-Researcher

____

Je consens à la participation de:

____
(patient)

à l'étude précitée et j'autorise par la présente le(s) médecin(s) et chercheur(s) à procéder aux examens et/ou à dispenser les traitements suivants:

I consent to the participation of:

____
(patient)

in the above study and hereby authorize the physician(s) and investigator(s) to proceed with the following examinations and/or to administer these treatments:

____

____

J'ai reçu une explication détaillée de tous les effets secondaires et des risques connus ayant trait aux examens et aux traitements.

J'ai également reçu une description de tous les avantages à attendre de ces examens et de ces traitements. On m'a fait connaître d'autres formes d'examens et de traitements.

J'ai eu l'occasion de poser des questions au sujet de ces examens et de ces traitements et on y a bien répondu.

On m'a dit que je pouvais retirer mon consentement et suspendre ma participation à l'étude à n'importe quel moment et pour quelque motif que ce soit.

En toute connaissance de cause, je consens volontairement à participer à cette étude.

I have had a detailed description of all the known side effects and risks related to the examinations and treatments.

I have also received a description of any benefits that may be expected from these examinations and treatments. Alternative forms of examinations and treatments have been disclosed to me.

I have been given an opportunity to ask questions concerning the examinations and treatments involved and the questions which I have asked have been adequately answered.

I have been told that I can withdraw my consent and stop my participation in the study at any time and for any reason.

With full knowledge of this, I voluntarily consent to participate in the study.

Nom-Name ____________ Signature ____________ Lien de parenté / Relationship ____________

PATIENT OU PERSONNE LÉGALEMENT RESPONSABLE / PATIENT OR PERSON LEGALLY RESPONSIBLE

2. TÉMOIN/WITNESS ____________ ____________ DATE ____________

Nom-Name Signature

HOPITAL GENERAL D'OTTAWA
OTTAWA GENERAL HOSPITAL
501 CHEMIN SMYTH ROAD OTTAWA, ONT K1H 8L6

AUTORISATION DE FOURNIR DES RENSEIGNEMENTS
AUTHORIZATION TO RELEASE INFORMATION

J'autorise par la présente ______________________
(nom de l'institution fournissant les renseignements)

I hereby authorize ______________________
(name of facility releasing information)

à fournir tous les renseignements nécessaires à:

to release all the necessary information to:

____
(nom et adresse de la personne/l'institution demandant les renseignements)
(name and address of person/agency requesting information)

provenant du dossier médical de:

from the medical record of:

1- ______________________
(nom du patient/name of patient)

2- ______________________
(nom du médecin/name of physician)

3- ______________________
(adresse du patient - address of patient)

4- ______________________
(date de naissance/date of birth)

5- ______________________
(nom du père/name of patient's father)

concernant le traitement/l'hospitalisation en date du:

concerning treatment(s)/hospitalization on:

____
(date(s) de traitement/hospitalisation)
(date(s) of treatment/hospitalization)

Je comprends que ces renseignements seront utilisés par le destinataire pour:

I understand that this information is to be used by the recipient for:

____

____

Nom-Name ______________ Signature ______________ Lien de parenté-Relationship ______________

(PATIENT OU PERSONNE LÉGALEMENT RESPONSABLE-PATIENT OR PERSON LEGALLY RESPONSIBLE)

Nom du témoin-Name of witness ______________ Signature ______________ Date ______________

VEUILLEZ ADRESSER TOUTE CORRESPONDANCE AU DÉPARTEMENT DES ARCHIVES MÉDICALES.

PLEASE ADDRESS ALL CORRESPONDENCE TO THE MEDICAL RECORDS DEPARTMENT.

Ontario

Form 14
Mental Health Act

Consent to the Disclosure, Transmittal or Examination of a Clinical Record under Section 29 of the Act

I, ______________________________________
(print full name of person)

of ______________________________________
(address)

hereby consent to the disclosure or transmittal to or the examination by ____________________
(print name)

of the clinical record compiled in ______________________________________
(name of psychiatric facility)

in respect of ______________________________________.
(name of patient) (date of birth, where available)

See Notes 4 and 5.

____________________ (witness)

____________________ (signature)

____________________ (if other than the patient, state relationship to the patient)

Dated the __________ day of ______________________________, 19 ____.

NOTES: 1. Consent to the disclosure, transmittal or examination of a clinical record may be given by the patient where mentally competent or, where the patient is not mentally competent, by the person authorized under section 1a of the Act to consent on behalf of the patient. See subsection 29(3) of the Act.

2. Clause 29(1)(b) of the Act provides,
"(b) 'patient' includes former patient, out-patient, former out-patient and anyone who is or has been detained in a psychiatric facility."

3. Clause 1(g) of the Act provides,
"(g) 'mentally competent' means having the ability to understand the subject-matter in respect of which consent is requested and able to appreciate the consequences of giving or withholding consent."

4. Subsection 1a(1) of the Act provides,
"1a.—(1) A person may give or refuse consent on behalf of a patient who is not mentally competent if the person has attained the age of sixteen years, is apparently mentally competent, is available and willing to give or refuse consent and is described in one of the following paragraphs:

1. The committee of the person appointed for the patient under the *Mental Incompetency Act*.
2. The patient's representative appointed under section 1b or 1c.
3. The person to whom the patient is married or the person of the opposite sex with whom the patient is living outside marriage in a conjugal relationship or was living outside marriage in a conjugal relationship immediately before being admitted to the psychiatric facility, if in the case of unmarried persons they,
   i. have cohabited for at least one year,
   ii. are together the parents of a child, or
   iii. have together entered into a cohabitation agreement under section 53 of the *Family Law Act, 1986*.
4. A child of the patient.
5. A parent of the patient or a person who has lawful custody of the patient.
6. A brother or sister of the patient.
7. Any other next of kin of the patient.
8. The Official Guardian."

See sections 1b and 1c of the Act regarding patients' representatives.

5. Where the consent is signed by someone other than the patient, the relationship to the patient must be set out below the signature.

O. Reg. 391/87, s. 10.

HEAD INJURY STUDY

To further our understanding of the effects of a head injury on psychosocial functioning, we would like to ask someone who knows you well some questions concerning your daily functioning.

We would appreciate it if you could provide us with the name, address, and phone number of a person you feel knows you well and would agree to participate in this study.

I allow Mr./ Ms./ Mrs. ________________________ to complete questionnaires concerning my day-to-day functioning. She/He can be reached at the following address:

Name:_________________________

Street:_______________________

City:_________________________

Postal Code:__________________

Home Phone Number:____________

Relationship to you: ________________________

Length of time this person has known you:__________________

Signature:_____________________

Date:__________________________

Witness:_______________________

APPENDIX F

RELATIVES' CONSENT FORMS

Dear ______________________________:

Your name was given to us by ____________________________
who is involved in our study of the effects of a head injury on psychosocial adjustment. He/She believed that you would be willing to help us in our study. We have enclosed a copy of the consent form filled out by ________________________.

As part of our research efforts in the Head Injury Study, we are interested in learning more about the effects of a closed head injury on the psychosocial functioning of an individual. Such information would help professionals assist the head-injured individual and his/her family adapt to the trauma.

We have decided to use questionnaires to obtain some important information from you. Most of the questions are multiple choice. We would appreciate it if you would complete the questionnaires alone and in an area where distractions are minimal. It should take you approximately one hour to do so.

Many of the questions are personal in nature. Please answer them as carefully as possible. All questionnaires will be analyzed without your name attached to it. Your responses will be kept in the strictest confidence.

If you agree to fill out the attached questionnaires, please sign the agreement below, complete the questionnaires, and return everything in the stamped self-addressed envelope.

Thank you very much for your time and consideration. If you have any questions, please do not hesitate to contact me during the day at 737-8490 (Ottawa General Hospital where I work part-time) or at 231-4272 at night.

____
Andree Tellier, M.A.
Research Coordinator

...2

I agree to participate in the Head Injury Study by completing two questionnaires. I understand the rationale of my participation and also understand that my responses will be kept strictly confidential. If the results are published in the scientific literature, I will not be identified in any way.

______________________________ (Signature)

__________________ (Date)

APPENDIX G

THANK-YOU LETTER

Andree Tellier, M.A.
Neuropsychology Dept.
Ottawa General Hospital
501 Smyth Road
Ottawa ; Ontario
K1H 8L6
(613) 737-8490

March 15th, 1989

Mr. Smith
XXX Smith Road
SmithVille, Ontario
XOX OXO

Dear Mr. Smith:

It was a pleasure getting to know you during our meeting of March 10th, 1989. Thank you so much for accepting to participate in the study being conducted at... (St. Vincent Hospital or Ottawa General Hospital). Your help and comments were very much appreciated!

As promised, I will send you a copy of the results towards the end of the study. This should take approximately 6 months. Until then, take care of yourself and good luck in everything that you do!

Sincerely yours,

____
Andree Tellier, M.A.
Neuropsychology
Module Q
Ottawa General Hospital

APPENDIX H

SUMMARY LETTER

Andree Tellier, M.A.
Neuropsychology
Ottawa General Hospital
501 Smyth Road
Ottawa, Ontario
K1H 8L6

January 29th, 1990

John Smith
1111 Smith Road
Smithsville, Ontario
XOX OXO

Dear Mr. Smith:

Well, as anticipated, the collection of data for our study entitled "The Psychosocial Adjustment of Traumatically Brain-Injured Patients" took approximately 6 months! As all the questionnaires have been returned and the results analyzed, here is an outline of the major findings of our research.

When reviewing the following results, please keep in mind that these are group results. As such, you may find that you differ from the group even though you are part of the group from which the results were generated. In other words, it is possible that some of the results may not be in agreement with your particular case. The primary purpose of the following summary is to inform you of the psychosocial adjustment of a group of people who, like you, have suffered a traumatic brain injury. Do not worry if you have difficulty understanding some of the results as some of these may not relate directly to you.

I hope that you will find these results helpful in understanding the common deficits caused by traumatic brain injuries. On the basis of the results presented herein, it may also be of interest to you to compare yourself to others who have suffered a similar injury.

I wish to thank you once more for all your help in our research project. Please extend my thanks to the individual who also agreed to participate on your behalf. Already, your participation has helped us better understand the impact that a traumatic brain injury has on an individual's psychosocial

.../2

functioning.

Thank you once again for all your help and my best wishes for a Happy New Year!!!

Yours sincerely,

Andree Tellier, M.A.
Neuropsychology
Ottawa General Hospital

Characteristics of the Sample:

** Note: "TBI" will replace "Traumatic Brain Injury" throughout the remainder of this letter.

Total number of subjects	50
Age of subjects	Mean: 27.2 years Range: 17-49 years
Sex	Males: 54% Females: 46%
Education	Mean: 12.3 years
Handedness	Right: 96% Left: 4%
Date of TBI	1984 to present
Severity of TBI	Mild: 18% Moderate: 22% Severe: 60%

Data Related to the Accident:

Causes of TBI	Motor Vehicle Accidents: 74% Falls: 16% Others: 10%
Under the Influence of Alcohol	22%
Skull Fracture	Yes: 44% No: 56%
Loss of Consciousness	Yes: 94% No: 6%
Coma Length	Mean: 14 days Range: 0 to 90 days
Post-Traumatic Amnesia (the period of time it takes your memory to be able to register daily information such as date or year)	Mean: 48.5 days Range: 1 to 210 days

<u>Note</u>: Patients having suffered a **severe TBI** experienced a significantly lengthier coma and post-traumatic amnesia than did patients with moderate and mild TBIs.

<u>Characteristics Related to Our Follow-up Evaluation</u>:

Average Time of Follow-up Post-TBI......................2.7 years

Third Party Chosen to Complete Questionnaires:
Parent or Spouse..................76%
Siblings/Friends/Children..........24%

<u>Results Related to Psychosocial Adjustment:</u>

Analysis of the spontaneous complaints voiced during the initial interview revealed the following areas of concern:

Complaints	% of Cases
Memory Problems	60%
Loss of Friendships	60%
Decreased Stamina Lack of Physical Endurance } Increased Fatigue	30%
Mood Changes Increased Irritability } Lack of Patience	22%

** As well, 55% of those who have resumed drinking since the accident have reported an increased sensitivity to the effects of alcohol.

* * *

The formal questionnaires used in this project revealed a lot of important information. For one, they highlighted the major areas of difficulties that head-injured patients experience. Results based on the overall group suggested that primary difficulties, in order of importance, arise in the areas of:

1. Work
2. Concentration and Alertness Behaviour
3. Recreation and Pastimes
4. Energy Level
5. Social Interaction
6. Emotional Behaviour

All physical areas such as mobility, ambulation and eating patterns were not significantly affected. Every participant reported a greater degree of psychosocial maladjustment (i.e., difficulties with social interaction or leisure activities) than physical impairment. This profile of results held true regardless of the severity of head injury (i.e., severe, moderate or mild) sustained.

Effect of Severity of Traumatic Brain Injury:

With respect to areas of functioning on which the severity of TBI had a significant impact, the following can be said: Only a few significant group differences were obtained between those who had sustained a severe injury and those with a mild head trauma. In comparison to mild TBI patients, severely head-injured patients:

-suffered from higher levels of occupational dysfunction
-were more withdrawn and motorically slow
-were less independent
-were judged to engage less frequently in socially-expected activities such as managing finances or working around the house

Note: On none of the above measures did the severe group differ significantly from the moderate one, or the moderate group differ from the mild one.

Comparison of Information Obtained From: 1) TBI Subject
2) Third Party

When the information obtained from a third party (such as a spouse, parent or friend) was compared to that provided by the participant, the following observations were made. Overall, the level of maladjustment or daily difficulties were reported as more severe by a third party than by the TBI subject himself/herself. Such discrepancy was particularly noted in cases where the head injury was severe. In cases where the participants had suffered a moderate or mild head injury, the testimonies provided by the participant and third party tended to be very similar.

* * *

APPENDIX I

DESCRIPTIVE FILE AND RAW DATA

```
TITLE        "PSYCHOSOCIAL FUNCTIONING OF TBI PATIENTS"

             THIS FILE CONTAINS THE COMMANDS WHICH DESCRIBE
             A.T.'S PH.D. DISSERTATION DATA.
             THE FILE INCLUDES:
                DATA LOCATION (DATA LIST)
                VARIABLE NAMES
                VARIABLE LABELS
                VALUE LABELS.
             EACH CASE IN THE DATA FILE CONSISTS OF 4 RECORDS...
                1ST PERSONAL INFO, GROUP, SEVERITY, WAISR, AND WMS
                2ND CVLT, VERBAL FLUENCY, NAMING TRAILS, WCST,
                MOTOR TASKS & COMPETENCY RATING SCALES
            3RD SIP
            4TH KATZ
          THE RESULTS OF THIS DESCRIPTIVE RUN ARE SAVED IN THE SPSSX SAVE
          FILE: 'ATDSCRPT SPSSXSF'

FILE HANDLE DATAIN NAME='ATDATA1 PHD'
FILE HANDLE DATAOUT NAME='ATDSCRPT SPSSXSF'
DATA LIST FILE=DATAIN RECORDS=4

      /1 GROUP 1   SSNUMBER 2-3   SEX 4   HAND 5   AGE 6-7   EDUC 8-9
         YRHI 10-11   MOSNEURO 12-13   TIMEFU 14-15   SO 16   LANG 17
         KNOWNED 18-20   SKULL# 21   LOC 22   COMA 23-27(2)
         GCS 28-29   PTA 30-33(1)   CT 34   ETOHHI 35
         SUSCEPT 36   LEGALEV 37   LEGALFU 38   TYPE 39   FSIQ 42-44
         VIQ 45-47   PIQ 48-50   DSPAN 51-52   DSFWD 53   DSBWD 54
         SIMIL 55-56   PICARR 57-58   BLDES 59-60   OBJASS 61-62
         DSYMBOL 63-64   WMSMQ 65-67   STORIES 68-70   VISREPRO 71-73
         PALT 74-76

      /2 CVLTTOT 1-2   SEMCLUS 3-4   SHDELAY 5-8   LGDELAY 9-12
         PERSVN 13-14   INTRSN 15-16   FAG 17-18   FASPERSV 19-20
         ANIMALS 21-22   ANIMPV 23-24   NAMING 25-27   TRAILAT 28-30
         TRAILAP 31-32   TRAILAE 33-34   TRAILBT 35-37   TRAILBP 38-39
         TRAILBE 40-41   WCSTNC 42-44   WCSTP 45-47   WCSTCAT 48
         WCSTPPC 49-50   WCSTPPR 51-52   WCSTTOTP 53-54   FINGPR 55-56
         FINGNPR 57-58   HANDPR 59-60   HANDNPR 61-62   PEGBPR 63-65
         PEGBNPR 66-68   COMPETPT 70-72   COMPETSO 73-75

      /3 SIPSR 1-4(1)   SIPEB 5-8(1)   SIPBCM 9-12(1)   SIPHM 13-16(1)
         SIPM  17-20(1)   SIPSI 21-24(1)   SIPA 25-28(1)   SIPAB 29-32(1)
         SIPC 33-36(1)   SIPW 37-40(1)   SIPRP 41-44(1)   SIPE 45-48(1)
         SIPPHYS 49-53(2)   SIPPSYCH 54-58(2)   SIPTOT 59-63(2)

      /4 KZBELLIG 1-2   KZEXPANS 3-4   KZNEGAT 5-6   KZHELPL 7-8
         KZSUSPIC 9-10   KZANXT 11-12   KZWRET 13-14   KZGENPSY 15-16
         KZNERV 17-18   KZCONFUS 19-20   KZBIZARR 21-22   KZHYPER 23-24
         KZSTAB 25-26   KATZR2 27-28
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FORMAT  COMA (F5.2)
        PTA  (F4.1)
        SIPSR SIPEB SIPBCM SIPHM SIPM SIPSI
        SIPA SIPAB SIPC SIPW SIPRP SIPE (F4.1)
        SIPPHYS SIPPSYCH SIPTOT (F5.2)

COMPUTE CVLTDELT=SHDELAY+LGDELAY

VARIABLE LABELS
   GROUP    "SEVERITY OF HEAD INJURY"
   SSNUMBER "SUBJECT IDENTIFICATION NUMBER"
   HAND     "HANDEDNESS"
   AGE      "AGE IN YEARS AT TIME OF INJURY"
   EDUC     "EDUCATION IN YEARS"
   YRHI     "YEAR OF HEAD INJURY"
   MOSNEURO "TIME IN MONTHS - H.I. TO NEUROPSYCH"
   TIMEFU   "TIME IN MONTHS - H.I. TO FOLLOW-UP"
   SO       "SIGNIFICANT OTHER"
   LANG     "LANGUAGE SPOKEN BY PATIENT"
   KNOWNED  "TIME IN MONTHS PT AND S.O. HAVE KNOWN EACH OTHER"
   SKULL#   "PRESENCE OF SKULL FRACTURE"
   LOC      "LOSS OF CONSCIOUSNESS AT TIME OF INJURY"
   COMA     "LENGTH OF COMA IN DAYS"
   GCS      "GLASGOW COMA SCALE"
   PTA      "POST-TRAUMATIC AMNESIA IN DAYS"
   CT       "CT SCAN FINDINGS"
   ETOHHI   "PRESENCE OF ALCOHOL AT TIME OF INJURY"
   SUSCEPT  "PRESENCE OF INCREASED SUSCEPTIBILITY TO ALCOHOL"
   LEGALEV  "LEGAL INVOLVEMENT AT ANY TIME"
   LEGALFU  "LEGAL INVOLVEMENT AT TIME OF FOLLOW-UP"
   TYPE     "TYPE OF ACCIDENT"
   FSIQ     "FULL SCALE IQ"
   VIQ      "VERBAL IQ"
   PIQ      "PERFORMANCE IQ"
   DSPAN    "DIGIT SPAN"
   DSFWD    "DIGIT SPAN FORWARD"
   DSBWD    "DIGIT SPAN BACKWARD"
   SIMIL    "SIMILARITIES"
   PICARR   "PICTURE ARRANGEMENT"
   BLDES    "BLOCK DESIGN"
   OBJASS   "OBJECT ASSEMBLY"
   DSYMBOL  "DIGIT SYMBOL"
   WMSMQ    "WECHSLER MEMORY SCALE - MEMORY QUOTIENT"
   STORIES  "WMS - RECALL IN PERCENTAGE OF WMS STORIES"
   VISREPRO "RECALL OF WMS DESIGNS IN PERCENTAGE"
   PALT     "RECALL IN PERCENTAGE OF WMS PAIRED ASSOCIATE WORDS"
   CVLTTOT  "CVLT - TOTAL CORRECT"
   SEMCLUS  "NUMBER OF SEMANTIC CLUSTERING"
   SHDELAY  "DECREMENT IN MEMORY OVER SHORT DELAY"
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LGDELAY  "DECREMENT IN MEMORY OVER LONG DELAY"
PERSVN   "NUMBER OF PERSEVERATIONS TRIALS 1-5"
INTRSN   "NUMBER OF INTRUSIONS TRIALS 1-5"
FAS      "F-A-S - VERBAL FLUENCY"
FASPERSV "PERSEVERATIONS ON FAS"
ANIMPV   "PERSEVERATIONS ON ANIMALS"
TRAILAT  "TIME IN SECONDS ON TRAIL A"
TRAILAP  "PERCENTILE SCORE ON TRAIL A"
TRAILAE  "NUMBER OF ERRORS ON TRAIL A"
TRAILBT  "TIME IN SECONDS ON TRAIL B"
TRAILBP  "PERCENTILE SCORE ON TRAIL B"
TRAILBE  "NUMBER OF ERRORS ON TRAIL B"
WCST#C   "NUMBER OF CORRECT RESPONSES ON WCST"
WCSTP    "PERCENTAGE OF CORRECT RESPONSE ON WCST"
WCSTCAT  "NUMBER OF CATEGORIES ON WCST"
WCSTPPC  "PERCENTAGE OF PERSEV. RESPONSES TO PREVIOUS CATEG."
WCSTPPR  "PERCENTAGE OF PERSEV. RESPONSES TO PREVIOUS RESP."
WCSTTOTP "PERCENTAGE OF TOTAL PERSEVERATIVE RESPONSES"
FINGPR   "FINGER-TAPPING SPEED WITH PREFERRED HAND"
FINGNPR  "FINGER-TAPPING SPEED WITH NON-PREFERRED HAND"
HANDPR   "HAND GRIP STRENGTH WITH PREFERRED HAND"
HANDNPR  "HAND GRIP STRENGTH WITH NON-PREFERRED HAND"
PEGBPR   "GROOVED PEGBOARD WITH PREFERRED HAND"
PEGBNPR  "GROOVED PEGBOARD WITH NON-PREFERRED HAND"
COMPETPT "COMPETENCY RATING SCALE - PATIENT"
COMPETSO "COMPETENCY RATING SCALE - RELATIVE"
SIPSR    "SIP - SLEEP AND REST ACTIVITY"
SIPEB    "SIP - EMOTIONAL BEHAVIOUR"
SIPBCM   "SIP - BODY CARE AND MOVEMENT"
SIPHM    "SIP - HOME MANAGEMENT"
SIPM     "SIP - MOBILITY"
SIPSI    "SIP - SOCIAL INTERACTION"
SIPA     "SIP - AMBULATION"
SIPAB    "SIP - ALERTNESS BEHAVIOUR"
SIPC     "SIP - COMMUNICATION"
SIPW     "SIP - WORK"
SIPRP    "SIP - RECREATION AND PASTIMES"
SIPE     "SIP - EATING"
SIPPHYS  "SIP - PHYSICAL ADJUSTMENT"
SIPPSYCH "SIP - PSYCHOSOCIAL ADJUSTMENT"
SIPTOT   "SIP - TOTAL PSYCHOSOCIAL ADJUSTMENT"
KZBELLIG "KATZ  BELLIGERENCE"
KZEXPANS "KATZ  EXPANSIVENESS"
KZNEGAT  "KATZ  NEGATIVISM"
KZHELPL  "KATZ  HELPLESSNESS"
KZSUSPIC "KATZ  SUSPICIOUSNESS"
KZANXT   "KATZ  ANXIETY"
KZWRET   "KATZ  WITHDRAWAL AND RETARDATION"
KZGENPSY "KATZ  GENERAL PSYCHOPATHOLOGY"
KZNERV   "KATZ  NERVOUSNESS"
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  KZCONFUS "KATZ  CONFUSION"
  KZBIZARR "KATZ  BIZARRENESS"
  KZHYPER  "KATZ  HYPERACTIVITY"
  KZSTAB   "KATZ  STABILITY"
  KATZR2   "LEVEL OF PERFORM. OF SOCIALLY-EXPECTED ACTIVITIES"
  CVLTDELT "CVLT - TOTAL DECAY IN MEMORY OVER TIME"

VALUE LABELS
  GROUP    1 "SEVERE"
           2 "MODERATE"
           3 "MILD" /
  SEX      1 "MALES"
           2 "FEMALES" /
  HAND     1 "RIGHT"
           2 "LEFT" /
  SO       1 "SPOUSE"
           2 "PARENTS"
           3 "BROTHER OR SISTER"
           4 "CHILD"
           5 "FRIEND"
           6 "CONJOINT OU AMI" /
  LANG     1 "FRENCH"
           2 "ENGLISH" /
  SKULL# LOC ETOHHI LEGALEV LEGALFU  1 "YES"
                                     0 "NO" /
  CT       1 "NORMAL"
           2 "ABNORMAL - FOCAL"
           3 "ABNORMAL - DIFFUSE" /
  SUSCEPT  1 "NO DRINKING"
           2 "NO SUSCEPTIBILITY"
           3 "INCREASED SUSCEPTIBILITY" /
  TYPE     1 "CAR"
           2 "MOTORCYCLE"
           3 "FALL"
           4 "HIT ON HEAD"
           5 "ATV"
           6 "PEDESTRIAN"
           7 "BICYCLE"
           8 "SKIDOO" /
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SAVE OUTFILE=DATAOUT
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